The New Zealand
Journal of Agriculture.

VOL. 48. WELLINGTON, 20TH APRIL, 1934. No. 4.

WINTON EXPERIMENTAL AND DEMONSTRATION FARM.

RECORD OF WORK FOR SEASON 1932–33.

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THE season of 1932–33 once again emphasized the fact that the management committee had encountered a particularly critical financial period for the change-over from sheep to dairy-farming. Butterfat actually sold during the year amounted to 8,504 lb. from forty-three cows, from which the butterfat per acre figures can be deduced as 93·45 lb.

In comparison with the previous year there has been a slight falling-off in production, due to seasonal conditions and lateness of calving, associated with the temporary sterility in evidence the season previous. The herd was not placed under group test last season, but this matter has been rectified for 1934, and in this connection it is pleasing to record an improvement in the test of the two- and three-year-old animals which have been reared at the area and sired by the purebred Friesian bull, "Dominion King Matador of Weraroa."

ROTATIONAL GRAZING INVESTIGATIONS.

The experiment originally laid down in September, 1928, was associated with an investigation into the merits or demerits of using sulphate of ammonia in addition to phosphate; and grazing returns and herd production were accurately recorded for each pair of fields since its inception. Particulars relating to the laying-down of this trial were recorded in the *New Zealand Journal of Agriculture*, Vol. 41, pp. 407–412. Last season the investigation was confined to three pairs of fields, Blocks 2A and 2B being ploughed early in the autumn, and Blocks 6A and 6B having been ploughed the autumn previous to provide supplementary feed. When the results are analysed a progressive reduction in the carrying-capacity and butterfat-production of the nitrogen fields is revealed. This has been accompanied by a reduction in the white clover content of the pasture and the gradual opening-up of the sward. In view of the above results, the continuous application of sulphate of ammonia to pasture season after season cannot be recommended in practice at Winton.

This season, as sulphate of ammonia has been thoroughly tried out on these trials, no further trials with nitrogen under the grazing system are being carried out; but grazing records are still being kept, and each field receiving nitrogen has been top-dressed with 2 cwt. per acre of carbonate of lime for each hundredweight of sulphate of ammonia it has received since 1928. The object of taking these records is to determine whether the differences in carrying-capacity between the phosphate and phosphate plus nitrogen fields were due to the acidifying effects of the sulphate of ammonia applied. At the same time, a reasonable test is provided for the uniformity of the fields for future trials, and also for providing an incentive to carry on the excellent pasture control achieved during previous seasons.

Swede Manurial Experiment.

In Block 9 a swede manurial trial was sown on the 1st November, 1932. The seed used was "Grandmaster," at the rate of 17½ oz. per acre sown on ridges 26 in. apart. Treatments were as follows:—

1. Superphosphate 3 cwt.
2. Superphosphate 3 cwt. plus carbonate of lime 3 cwt.
3. Superphosphate 3 cwt. plus carbonate of lime 3 cwt. plus 30 per cent. potash salts 1 cwt.
4. Superphosphate 3 cwt. plus carbonate of lime 3 cwt. plus 30 per cent. potash salts 1 cwt. plus blood and bone 1 cwt.
5. Superphosphates 3 cwt. plus 30 per cent. potash 1 cwt.

In each treatment approximately five-sixths of the fertilizer was sown from the front box (below the seed), and one-sixth from the rear box (with the seed). The crop was weighed on the 21st July, 1933, and the summary of yields, supplied by the Crop Experimentalist, is as follows:—

Treatment per Acre.	Quantity actually sown, in Pounds.	Yield, in Tons per Acre.
1. Super 3 cwt.	340	57·0
2. Super 3 cwt. plus lime 3 cwt.	624	54·8
3. Super 3 cwt. plus lime 3 cwt. plus potash 1 cwt. ..	861	58·6
4. Super 3 cwt. plus lime 3 cwt. plus potash 1 cwt. plus blood and bone 1 cwt.	954	60·0
5. Super 3 cwt. plus potash 1 cwt.	496	57·0

Each yield is the average of ten weighings of single rows each of which was 33 ft. in length. The only significant fact was that the yield of treatment No. 3 (super 3 cwt. plus lime 3 cwt. plus potash 1 cwt.) was significantly greater than that of treatment No. 2 (super 3 cwt. plus lime 3 cwt.). Other differences are not significant. The incidence of disease (club-root and dry-rot) was practically the same over all treatments.

Swede Variety Trial.

In the same block as the above a variety trial, incorporating fourteen strains or varieties, was sown on the 31st October, 1932. Seeding was at the rate of 17½ oz. per acre, and a mixture of two parts of superphosphate and one part of blood and bone was sown at the rate of 3 cwt. per acre. The seed was ridged in drills 26 in. apart, and the

drills were rolled immediately after sowing. The crop was thinned by hand on the 20th December, 1932. Weights were taken on the 20th July, 1933, and the Crop Experimentalist supplies the following results :—

Variety.	Yield, in Tons per Acre.	Remarks.
SECTION A.		
1. R 34	61·3	Significantly better than 3, 5, 6, and 7.
2. Picton	55·6	Significantly better than 6.
3. Imrie's Improved ..	52·5	
4. Number One	56·4	Significantly better than 5 and 6.
5. Bangholm (Ayr) ..	51·5	
6. Herning (Gore Selection)	47·7	
7. Sutton's Green Top ..	50·2	
SECTION B.		
8. Sensation	60·2	Significantly better than 9, 10, 11, 12, and 13.
9. Bangholm (Price) ..	44·7	Significantly lower than remainder in Section B.
10. Earliest of All ..	51·9	
11. Ne Plus Ultra ..	52·4	
12. Skirvings	54·4	
13. Defiance	51·9	
14. New Colossal Tipperary	57·1	Significantly better than 13.

On account of the layout of the trial, varieties in Section A are not comparable with those in Section B.

TURNIP VARIETY TRIAL.

In Block 3 a turnip variety trial was laid down, but owing to a serious club-root attack it was fed off at an early stage by a line of 150 lambs purchased for this purpose.

The other trial of interest was in connection with the Bruce turnip, an account of which has already been published in the *New Zealand Journal of Agriculture*, Vol. 47, pp. 297–301. Some three hundred selected bulbs have been transplanted and will be saved for seed this season.

OTHER CRUCIFEROUS TRIALS.

In Block 6, which was mainly sown to chou moellier for autumn and early-winter feeding of the dairy herd, two small trials were of interest. Small blocks of rape kale (early type), buda kale (rape type), buda kale (cabbage type), and Maori cabbage were sown out on land known to be infected with club-root. It was noted that the Maori cabbage developed club-root very severely, but its growth was not interfered with to a great extent. On a neighbouring farm, where an acre of each was sown and fed off, twenty-one lambs were placed on each block on 8th April, 1933, and on 11th May, 1933, the lambs were drafted as follows : Maori cabbage, 21 fat ; buda kale rape type, 21 fat ; buda kale cabbage type, 20 fat (1 not quite prime) ; rape kale early type, 19 fat (2 left).

From this it will be seen that Maori cabbage stood up very well in comparison with buda kale, although the lambs produced on the Maori cabbage were lighter than those produced on kale blocks.

Source of Seed-potato Trials.

In conjunction with ten other farms in the South Island, a certified Dakota crop was grown last season at Winton. The crop weighed as follows: Table, 6·2 tons per acre; seed, 1·6; small, 1·6: total, 9·4 tons per acre.

This yield places Winton fifth equal on the list. A bag of seed produced from each centre is being grown this year at a central yield trial at Rangiora. A further area has again been sown at each local centre.

In previous years the variety Arran Chief had been used, and it had been established that under colder conditions and in isolated areas generally there is less incidence of aphides and consequent spread of virus disease. Southland, amongst favoured localities, should therefore be looked to for seed by other provinces as Scotland is looked to by English growers.

Grass and Clover Strain Trial.

The two hundred cocksfoot and red and white clover plots laid down in Field 5 have not afforded much interest, except that the certified mother white clover strain (more generally known as New Zealand No. 1) is an outstanding clover for production of herbage. Montgomery red clover has also shown fair persistency under grazing conditions. The cocksfoots, with the exception of the Plains and Akaroa strains, have not proved an unqualified success when sown in competition with the rye-grass base used.

The corresponding rye-grass trials in Field 7 present evidence as to the persistency of the certified type, but they have also provoked controversy as to whether persistency can be influenced by palatability or close grazing. To throw further light on this question Block 6 has been sown out, one-half with certified rye-grass and the other half with a mixture of five commercial local lines. With both lines, white clover was included. Grazing and production records will be kept in conjunction with the rotational grazing records.

Effect of Nitrogen on Young Pasture.

Block 13, sown down in November, 1931, with certified rye-grass, timothy, crested dogstail, red and white clover, together with 2½ bushels of oats (which were later cut for hay), was top-dressed in the following March with 2½ cwt. per acre of superphosphate. On the 10th September, 1932, strips were top-dressed across the width of the field with 4 cwt., 2 cwt., and 1 cwt. per acre of sulphate of ammonia. From the outset a decided stimulation of the rye-grass occurred, with the consequent reduction of the clover content. At the present time, even after two cuts of hay have been taken, the 4 cwt. strip can be clearly distinguished, although the 2 cwt. and 1 cwt. strips now closely approximate in composition the remainder of the field, which is clover dominant.

A peculiar feature this spring was that this 4 cwt. strip of dominant rye-grass was the only part of the paddock severely attacked by *Porina* and grass-grub. As a consequence, growth has not been so heavy on this strip.

On this block a rate of liming trial was laid down this spring, carbonate of lime being applied at 1 ton, 2 tons, and 4 tons per acre these strips crossing the sulphate of ammonia strips.

GENERAL.

The laying-down to permanent pasture of Block 15 has improved the appearance of the area greatly, but there is still need of further shelter.

Material financial assistance has been provided by the trustees of the R. M. MacKinnon Estate, as in past years, and the committee wishes to place on record its appreciation of this valuable aid.

Favourable mention is accorded to the farm manager (Mr. G. L. Smart) for the manner in which the committee's programme of work has been carried out under the popular chairmanship of Mr. D. H. McLean, Caroline.

THE RELATION BETWEEN FAULTY WINTER FEEDING OF EWES AND THE SUSCEPTIBILITY OF THEIR LAMBS TO PULPY KIDNEY.

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[The following is a report of research work at present in progress at Canterbury Agricultural College. It should be noted that finality has not been reached and further research is being conducted.—THE AUTHOR.]

ALTHOUGH the essential pathology of entero-toxæmia (pulpy kidney) in lambs was considerably advanced by the tracing of the ultimate cause to a bacterial toxin(s), Koch's postulates remained unsatisfied and further investigation was rendered necessary(1), (2), (3).

A large-scale experiment with over eight hundred ewes and their progeny was therefore begun in 1932 on a Canterbury plains farm where pulpy kidney occurs. The husbandry conditions, soil, and climate have been described in a previous issue of this *Journal*(4). It was also shown that feeding conditions for about eight months of the year from January till August were generally poor. In 1933 a very dry summer and the consequent failure of the root crop resulted in an even more severe shortage of feed up to lambing than occurred in 1932. In what follows therefore an appreciation of the cumulative undernutrition to which the experimental sheep have been subjected is most important. The long periods during which the flock was necessarily fed on poor pasture, green oats, oat-sheaf chaff, and turnips should be sufficient indication that not only quantitative but also qualitative undernutrition, especially with respect to minerals and protein, was serious.

VALIDITY OF USING LIVE-WEIGHTS AS A MEASURE OF NUTRITION.

Ewes and lambs were ear-tagged or tattooed and weighed periodically. A record of body-weights has thus been secured, which, used as a measure of nutrition, provides evidence to implicate faulty preparturient dieting of the ewe as a factor predisposing the lamb to pulpy kidney.

The use of live weights as a measure of the quality and quantity of feed is open to the objection that phenomena of etiological importance which are detectable by immunological and biochemical methods may not be reflected in changes of body-weight. There is the possibility, for example, that the crossbred nature of the lambs (Romney and English and Border Leicester ewes × Southdown rams) might

have some effect on their resistance to disease. Further, when there are only small differences in the feeding of different groups of animals, individual variations may effectively prevent any noticeable change in relative weights between such groups. Although these considerations apply to the experiments discussed here, the data derived from them is suggestive and recorded for the benefit of those interested in the disease.

Field Observations in Canterbury, and their Interpretation.

Extensive field-work in 1931–32(5) indicated that a correlation existed between the nutritional condition of ewes at lambing and the susceptibility of the offspring to "wool-ball," pulpy kidney, &c. It was found that the incidence was highest among the offspring of ewes wintered on poor pasture which showed little green growth before lambing and in flocks receiving an abundance of roots over a long period without supplementary feed. Investigations(6) into the etiology and prevention of ante-partum paralysis of twin-bearing ewes showed also that, where improved dietary conditions prevented ante-partum paralysis, the incidence of "wool-ball," pulpy kidney, and lamb mortality at birth noticeably decreased.

Experience during the lambing season of 1933–34 confirms that of previous years, and it is suggested that the following data indicate that faulty feeding of pregnant ewes adversely affects the nutritional (immunological?) status of the newborn lambs and renders then less able to resist the disease.

Detailed Histories of Six Cases of Pulpy Kidney.

Changes in body-weight from March till August in 1932 and in 1933 of six ewes whose lambs died of pulpy kidney in 1933 are discussed herein. Although similar results were obtained in 1932, the microscopic and biological diagnoses which have been kindly undertaken this year by Mr. D. A. Gill, Wallaceville Veterinary Laboratory, Wellington, and in his absence by Mr. C. S. M. Hopkirk, Officer in charge, were not made. To avoid the possibility of inaccurate macroscopic diagnoses, details only of positive cases in 1933 are given, and these are limited to those ewes which possess histories for two years.

The following table sets out in pounds the body-weights of the six ewes referred to below.

Ewe No.	Year.	Mar.	May.	June.	July.	Aug.
1254	1932	101	91	89	99	113
	1933	91	..	88	90	91
212	1932	110	104	120	132	131
	1933	112	..	118	115	114
762	1932	81	82	90	92	100
	1933	86	83	78	..	88
315	1932	96	93	108	114	116
	1933	116	..	93	..	94
718	1932	79	87	92	95	98
	1933	77	..	79	..	86
474	1932	98	97	117	122	122
	1933	106	..	91	..	91
Dry ewes	1932	90	89	..	101	103
	1933	104	96	90	..	88

The March weighings were made just before tupping and the August weighings just before lambing. The ewes showed a somewhat better condition in 1932, but the plane of nutrition is considered to be low in both years and characteristic of the class of land in Canterbury.

The histories of the cases in some detail are:—

CASE NO. 1: EWE NO. 1254. ENGLISH LEICESTER CROSS, FULL-MOUTHED.

1932. Fleece-weight, 6·5 lb.; body-weight, 1st November, 1932, 102 lb.; lambed 26th September, 1932; male; birth weight, 11 lb.; growth-rate per day, 0·53 lb. (healthy).

1933. Fleece-weight, 5·4 lb.; body-weight, 15th November, 1933, 89 lb.; lambed 1st September, 1933; male twins; birth weight, 6·3 lb. and 5·5 lb. (dead, pulpy kidney); growth-rate to death, 0·304 lb. per day; days old at death, 14. Uncastrated.

Comment.—In spite of the fact that she was 19 lb. lighter at lambing in 1933, this ewe produced twins of a total birth weight of 11·8 lb. During the critical part of her gestation period, dry ewes failed to maintain their weight under the same husbandry and feeding conditions. Pregnant ewes must therefore have had to draw on their own body reserves to nourish their offspring. As a result of the drought from January to June, 1933, before winter feeding started these reserves could have been but poorly built up on a diet deficient minerally and otherwise.

The growth-rates of lambs which are given in this and the following comments are comparable, and extend over the pulpy-kidney period.

CASE NO. 2: EWE NO. 212. BORDER LEICESTER, EIGHT-TOOTH.

1932. Fleece-weight, 5·9 lb.; body-weight, 19th December, 1932, 123 lb.; lambed 30th August, 1932; single, 9½ lb.; growth-rate per day, 0·62 lb. (healthy).

1933. Fleece-weight, 4·8 lb.; body-weight, 15th November, 1933, 118 lb.; lambed 8th September, 1933; male twins; birth weight, 6·1 lb. and 4·5 lb. (dead, pulpy kidney); live-weight increase per day to death, 0·388 lb.; days old, 9. Uncastrated.

Comments.—The above data show, as in other ewes referred to, that the wool yield is less in 1933 than 1932. Shearing took place in November. This is in keeping with drought conditions, which also reduced fertility and increased the percentage of dry ewes. This ewe increased 28 lb. in body-weight from May to August in 1932, but in 1933, although about the same weight at mating, she weighed approximately the same weight before lambing twins. The mortality among twins, their growth-rates, and the unsuitability of the dietary conditions on this farm for economic twin production will be dealt with later.

CASE NO. 3: EWE NO. 762. ROMNEY CROSS, SIX TO EIGHT TOOTH.

1932. Fleece-weight, 7·8 lb.; body-weight, 19th December, 1932, 86 lb.; lambed 7th September, 1932; single, 9½ lb.; live-weight increase per day, 0·46 lb. (healthy).

1933. Fleece-weight, 7·1 lb.; body-weight, 16th December, 1933, 95 lb.; lambed 29th August, 1933; single, 8·3 lb.; live-weight increase per day, 0·513 lb. to tailing, two days before death.

Comment.—As a two-tooth in 1932 this ewe should have begun her second pregnancy with a greater body-weight than she had during her first. Other two-tooth ewes which did not bear a lamb in 1932 and were run with the in-lamb ewes did show an average increase of 24·7 lb. from March, 1932, to March, 1933. The average increase for two-tooths that produced lambs was 7·6 lb. The plane of nutrition in 1932 was therefore not high enough for this two-tooth ewe to produce a lamb, 7·8 lb. of wool, and put on more than 6 lb. of body-weight. Elsewhere(4) we have noted that the teeth of the above dry two-tooth ewes were sounder than those that produced offspring in addition to wool.

CASE NO. 4: EWE NO. 315. ROMNEY CROSS, SIX TO EIGHT TOOTH.

1932. Fleece-weight, 6·7 lb.; body-weight, 19th December, 1932, 122 lb.; lambed 26th September, 1932; single, 9 lb.; live-weight increase per day, 0·53 lb. (healthy).

1933. Fleece-weight, 6 lb.; body-weight, 15th November, 1933, 116 lb.; lambed, 20th August, 1933; single, 7·6 lb.; live-weight increase per day, 0·45 lb. to death at eighteen days old.

Comment.—Just before lambing this ewe was 20 lb. lighter than she was at the same time the previous year. In this case, as in case No. 6, the record of body-weights indicates very poor preparturient dieting.

CASE NO. 5: EWE NO. 718. ROMNEY CROSS, SIX TO EIGHT TOOTH.

1932. Fleece-weight, 8·4 lb.; body-weight, 19th December, 1932, 88 lb.; lambed, 10th September, 1932; single, 9 lb.; live-weight increase per day, 0·47 lb. (healthy).

1933. Fleece-weight, 5·8 lb.; body-weight, 15th November, 1933, 96 lb.; lambed, 9th September, 1933; single, 9·4 lb.; live-weight increase per day, 0·624 lb. to death, nineteen days old.

Comment.—Possibly this ewe is still showing the effect of lamb-production in 1932 when she was a two-tooth (see comments under case No. 3). The live-weight increases per day of the lambs succumbing in 1933 (see notes for cases Nos. 3 and 5) are greater than those of the offspring of the same ewes in 1932 in spite of the poorer condition of the dams. This may be partly due to the fact that on this farm the offspring of two-tooths make slower growth than the progeny of more mature ewes (unpublished data).

CASE NO. 6: EWE NO. 474. CROSSBRED, FAILING MOUTH.

1932. Fleece-weight, 7·1 lb.; body-weight, 19th December, 1933, 112 lb. lambed, 31st August, 1932; single, 10½ lb.; live-weight increase per day, 0·57 lb. (healthy).

1933. Fleece-weight, 6·3 lb.; body-weight, 15th November, 1933, 106 lb.; lambed, 15th September, 1932; single, 9 lb.; live-weight increase per day, 0·477 lb. to marking and 0·427 lb. to death, when thirty-four days old. Death occurred nineteen days after castration.

Comments.—Case No. 6 is similar to case No. 4, and shows that the ewe is on the down grade before lambing. In an examination of over 1,500 ewe records we have not encountered pulpy kidney in the offspring when the converse has been well marked.

The records of the average body-weights of the dry ewes in 1932 and 1933, run under the same conditions as the in-lamb stock, show that the 1933 dry ewes lost weight from mating to lambing and, during the winter period, which coincides with the critical part of the gestation period, barely maintained themselves. It is noteworthy, moreover, that the 1932 dry ewes more than made good during the spring and early summer and commenced the next conception period at much higher weights (see comments under case No. 3). The fact that dry ewes build themselves up during the lactation period of the flock may apply equally to ewes losing their lambs soon after birth, and may explain why they may not lose their lambs from pulpy kidney in successive seasons.

FURTHER EVIDENCE FOR THE SUGGESTION THAT FAULTY FEEDING OF PREGNANT EWES PREDISPOSES LAMBS TO PULPY KIDNEY.

(*a*) *Time of Lambing.*—In 1932 it was found on our experimental farm that the incidence of lamb-mortality from pulpy kidney, wool-ball, &c., was highest in the offspring of early lambers that had less chance of picking up on green spring growth than the late lambers in the same flock which benefited considerably from natural green herbage. In the same year it was found also that as the birth weights of lambs increased with later lambing the mortality from all causes decreased. In 1933, to show that ewes improved in condition as lambing proceeded, body-weights were recorded about the middle of the season and showed increases varying from 15 lb. to 20 lb., during the previous month. This increase coincided with the supply of spring herbage.

(*b*) *Birth Weight of Lambs.*—It has not been possible to correlate birth weight with susceptibility. The explanation of this may be in the inability of a balance to distinguish between size and constitution. The size of a lamb at birth may give no idea at all of the nutritional status with regard to disease resistance. In

other words, large lambs do not necessarily possess better powers of resistance than smaller lambs. It is conceivable, moreover, that large single lambs would show the effects of faulty intra-uterine nutrition more than small ones and not much less than twins, which will be shown later to be more susceptible than singles.

The increase in birth weight which accompanies later lambing is, of course, a different matter.

(*c*) *Percentage of Lambs born Dead, or dying within Three Days.*—Under some circumstances a diminution of losses from diseases may be associated with earlier or later lambing or with a particular season. Since it is possible that the mortality at birth has a direct influence on the number of potential pulpy-kidney cases this association may be partly explained by the circumstances determining losses at birth or soon after. Experimental evidence here(7) and elsewhere(8) supports this contention, and consequently the calculation of the number of deaths occurring two, four, and eight weeks after lambing should be qualified by the number of deaths at birth or soon after. For example, lamb-mortality at birth may be high and the incidence of pulpy kidney low in one season, whereas the converse may be true in another. Annual and seasonal variations in the quality and quantity of the feed are probably closely related to this distribution of lamb losses. In support of this we find that in 1932 10 per cent. of twins died within three days of birth from obscure causes, probably nutritional in origin, and another 5 per cent. died during the pulpy-kidney season. In 1933 the corresponding percentage losses were 5·7 per cent. and 7·7 per cent. The mortality among singles in 1932 and 1933 from obscure non-specific causes was 7·5 per cent. and 1·8 per cent. respectively up to the third day after birth. Total losses from then till the end of the pulpy-kidney season amounted to 4·2 per cent. and 2·3 per cent. respectively.

(*d*) *Susceptibility of Twins.*—Of twelve positive biological tests for pulpy kidney three were made on twins—that is, 25 per cent. Apart from the fact that 5·7 per cent. of the thirty-five sets of twins and only 1·8 per cent. of the singles died within three days of birth, 25 per cent. of the losses from pulpy kidney occurred among twins surviving the three-day period, although there were at least ten times as many single lambs. The higher susceptibility of twins is thus illustrated. Twins reared as twins show only 77 per cent. of the growth rate of singles reared on mature ewes, and under husbandry conditions unsuitable for twin production this poor thrift must have considerable etiological significance.

(*e*) *Milk-production of Ewes.*—Excessive milk consumption has been suggested as a factor predisposing to pulpy kidney, but no experimental evidence in support of such a contention is available(2). Post-mortem examinations have revealed masses of milk-clots in the abomasum of lambs dead of pulpy kidney, but these may be an effect and not a cause. In this connection it is interesting to note that in 1932, and again in 1933, all twin lambs reared as singles on foster mothers remained healthy and showed good growth gains in spite of low birth weights; 5·3 per cent. and 4 per cent. respectively were transferred. In our experimental flock, pulpy kidney was confined to twins reared as twins, one or both succumbing, or to one member of a pair reared on its own mother, the other member having died at birth. It may be noted

in this connection that we have evidence to show that the production of twin lambs under our conditions, by causing an extra drain on the ewe, has the effect of reducing the milk yield below that of ewes producing singles. Greater milk consumption, therefore, would seem to be a preventive for pulpy kidney rather than a precipitant, as none of the transfers died. It is contrary to the hypothesis that high milk consumption is predisposing, and suggests that either faulty intra-uterine nutrition and low milk yield or both are factors of prime etiological significance in susceptibility to pulpy kidney.

(*f*) *Feeding and the Composition of Milk.*—The chemical composition of ewes' milk as opposed to its biological (immunologic ?) value is practically fixed for all feeding conditions ; the quantity mostly is affected by under- or mal-nutrition(9). Since the milk is a complete food, a lamb born under certain deficiencies may make them good by high milk consumption. It may later have access to suitable green feed which would be similarly useful, but if neither sufficient milk nor green feed is available then congenital deficiencies may lead to susceptibility to disease.

Apart from the inherited qualities and nutritional status possessed by new-born lambs, it can be stated with a good deal of authority that the greatest impetus to health and growth in young lambs is largely received from the nourishment provided by the dam—that is, the offspring of good milking-ewes grow more quickly than lambs born of ewes possessing low milking-powers. In the light of what has been said, the growth gains of lambs dying of pulpy kidney become of interest. Calculations of growth rates based on the birth weight, age in days, and the dead weight of the lamb, without weighings in between, are open to the criticism that dependence is placed on dead weight and does not allow for inhibition of growth due to unnoticeable indisposition before death, if such occurs.

(*g*) *Growth-rates of Lambs dying of Pulpy Kidney.*—In five out of six cases diagnosed biologically body-weights were recorded some time before and again after death. The results show that lambs developing pulpy kidney were slow thrivers. In addition, when the growth-rate of lambs dead of pulpy kidney were compared with the average gains of twenty lambs of the same birth weight and sex, and born within eight days of the lambs that died, it was found that in no case did the growth-rates of the pulpy-kidney lambs (measured in pounds per day) exceed that of like individuals reared under the same conditions. These findings lend support to the view that faulty prenatal nutrition and low milk consumption are factors of predisposition. If these deductions are correct, it is conceivable that lambs which are potential pulpy-kidney cases at birth may become nonsusceptible by high milk consumption in early life. The good progress made by all twins reared on foster mothers in 1932 and 1933 supports such a contention.

(*h*) *Ingestion of Foreign Substances.*—The tendency of the new-born lamb to nibble at and ingest foods and substances beyond its powers of digestion, and therefore inimical to normal digestion, commonly accompanies pulpy-kidney disease, but the agencies responsible for this form of pica or depraved appetite are imperfectly understood. A two-day observation in 1931 on two flocks of young lambs born of well and of poorly nourished dams revealed information which suggests that the offspring of poorly nourished ewes are more prone to premature ingestion of foreign matter than those of well nourished high milkers.

The amount and quality of herbage available to the lambs did not seem to influence the position. From these observations and other data(10) it is held that the premature consumption of foreign substances by young lambs is a deliberate attempt on their part to balance up their nutritional status, improverished by faulty intra-uterine nutrition, and uncorrected by the milk yield of the dam. The connection between this and other secondary agencies altering the environment of the causal organism or organisms(5) in the alimentary canal and causing it to become virulent is outside the scope of this paper. Further work embracing a study of the effects of an inadequacy of the various food ingredients and their effect on the immunologic mechanism of the new born seems a promising line of attack for future investigations.

Discussion.

The reported appearance of the disease under very diverse dietary and husbandry conditions and the paucity of experimental evidence concerned with factors of predisposition are no doubt responsible for the numerous hypotheses of predisposition and also for the few measures of prevention recommended.

From the data presented it is difficult to overlook the obvious part that a diet barely capable of maintaining the body-weight of dry stock can have on twin producers, on two-tooth ewes carrying their first offspring and presumably still growing, and on adult ewes whose constitutions are subjected to considerable fluctuations in nutrition from year to year and probably depleted through production.

It is found, with Gill and Hopkirk(2), that docking and castration precipitate the disease in susceptible flocks and, as a consequence, tailing and castration when lambs are better grown is recommended. It would seem, however, that the not infrequent higher incidence of females succumbing to pulpy kidney after docking is due to the greater mortality among males earlier in life, in addition to ante and post natal nutritional influences. In the experiments in 1933 the greater loss of males at and within three days of birth was in the ratio of two males to one female. The finding regarding greater mortality among males at or soon after birth and its possible connection with the incidence of disease is in harmony with observations on other animals(11), (12).

Summary.

In a preliminary report on the factors predisposing young lambs to entero-toxæmia (pulpy kidney) evidence is brought forward to implicate faulty feeding of the dam as one factor.

A comparison between body-weights of in-lamb ewes and dry ewes has been employed in a study of the effects of reproduction under the particular conditions of the experiments.

Faulty maternal nutrition is believed to operate in two ways: (*a*) By causing impoverishment of the nutritional status of the new born, and (*b*) by lowering the milk yield of the dam.

Etiological significance is attached to the higher susceptibility of twins and the importance of a knowledge of lamb-mortality at birth and differential sex mortality are stressed.

Live-weight increase per day is used to study the growth-rate of lambs. It has been shown that susceptibility and slow growth are closely associated. The ingestion of foreign substances is considered to be secondary to faulty prenatal nutrition and poor milk-production.

Evidence is advanced to show that a correlation exists between the time of lambing and susceptibility to pulpy-kidney disease and other conditions in so far as lambs born of ewes that had reached a low plane of nutrition at lambing were far more susceptible to disease than better-nourished lambs born three to four weeks later of a similar class of ewe that had access to green spring growth for some time before lambing.

No conclusions are drawn regarding the particular deficiencies leading to faulty preparturient dieting on this farm, but it is noteworthy that rapid decay of the teeth is common, breeding efficiency is low, and that natural growth meets the food requirements of the flock for about four months of the year only.

Based on the above findings, improved dieting of in-lamb ewes is suggested as one preventive for pulpy-kidney disease.

Acknowledgments.

It is a pleasure to make the following acknowledgments: To the New Zealand Meat Producers' Board which, with the assistance of various Canterbury agricultural and pastoral associations, the Canterbury Sheep-owners' Union, the Sheep Breeders' Association, various branches of the North Canterbury Branch of the New Zealand Farmers' Union, defrayed much of the expenditure incurred in the investigation; to Messrs. Gill and Hopkirk, of the Wallaceville Veterinary Laboratory, who kindly undertook the diagnoses and gave other assistance; to Mr. H. P. Donald, B.Sc., M.Agr.Sc., for assistance at various times; to Mr. Hines, the farm-manager on the experimental property; and to Mr. J. Linton for assistance during shearing and at other times.

In conclusion, I wish to record the fact that Mr. J. W. Mclean, B.Agr.Sc., assisted largely in the experiments upon which the deductions are based. He has devoted much time to the interpretation of the records, and, in addition to the field-work, has been of valuable assistance in compiling this report.

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THE NEW ZEALAND ARMY WORM.

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AN outbreak of destructive caterpillars in the Ashburton County in October of 1933 was due to *Persectania ewingi* Wwd. *(P. composita, Melanchra composita)*, more commonly referred to as the New Zealand army worm. The word "worm" in this respect is incorrect, and the only ground justifying its retention is the matter of long usage. A better common name to apply to the pest would be New Zealand army caterpillar, as the insect concerned is a typical moth larva. Other caterpillars commonly associated with *P. ewingi* are *Cirphis unipunctata* Haw. and *Heliothis obsoleta* Fabr., but only *P. ewingi* will be considered here, as it is the one mainly responsible for the outbreak. It passes through four typical stages in its life-history—viz., egg, larva or caterpillar, pupa or chrysalis, and finally adult or imago.

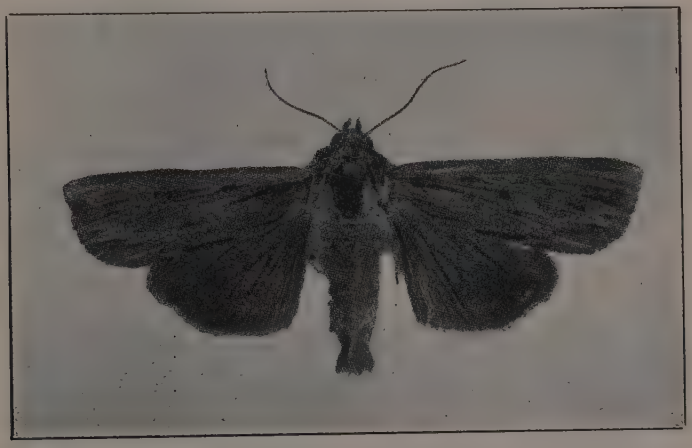

FIG. 1. THE ADULT INSECT, OR MOTH, OF THE NEW ZEALAND ARMY WORM.

The Adult.—The adult insect (Fig. 1) is a moth, the body of which has a short, thick-set appearance with a wing expanse of about 1½ in. The forewings are irregularly streaked with white, while the hind wings are an even dark to light-brown shade. It is a night-flying species, and rests during the day among grasses and on posts and trees, &c. This stage of the insect is the reproductive and distributive phase. The adult insect is short-lived and depends for its nourishment on the nectar of flowers. It is strongly attracted by light, and hence it is one of the commonest species found flying around lights at certain seasons of the year.

The Egg.—The eggs are very tiny objects, and are commonly laid on or amongst weeds, grass, or stubble. Several hundreds are deposited by a single female.

The Larva.—The larval or caterpillar stage (Fig. 2) is the stage in which the insect grows and feeds, and it is in this period of its life-cycle that it attracts most attention on account of its occasional serious

attacks on farmers' crops. The young larva on first hatching from the egg is very small and is not readily seen, but with subsequent feeding it soon develops into a comparatively large caterpillar measuring up

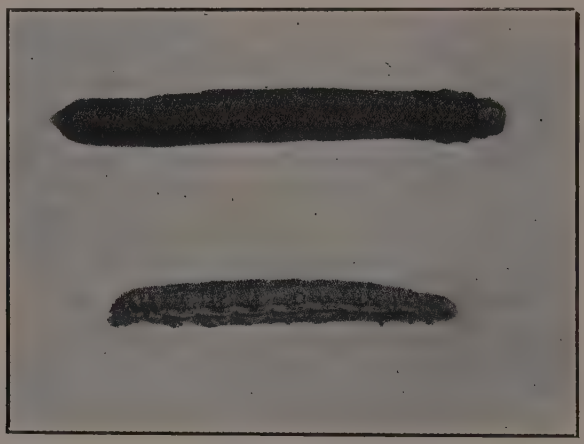

FIG. 2. THE LARVA, OR CATERPILLAR, OF THE NEW ZEALAND ARMY WORM.

to 1½ in. or more in length. The colour of the larva is variable. Hudson (1928) describes it as bright reddish-brown; there is a broad, black, dorsal stripe, and dull-red, white, and black lateral lines. When disturbed the caterpillars curl up in hoop-like fashion. When not feeding they lie hidden under debris or under clumps of earth.

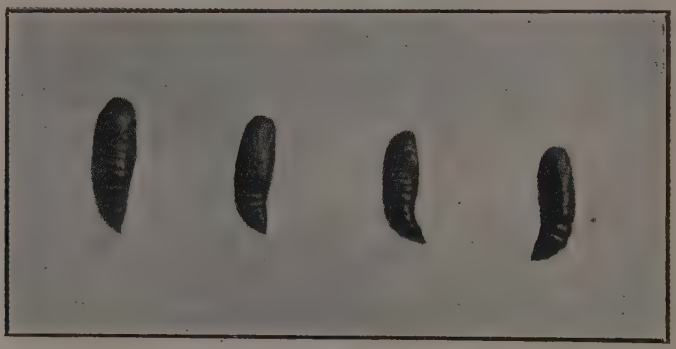

FIG. 3. PUPAE OF THE NEW ZEALAND ARMY WORM.

The Pupa.—The reddish-brown pupal stage (Fig. 3) into which the caterpillar changes is the resting and transformative stage during which no nourishment is taken. Adult characteristics are acquired prior to the emergence of the adult moth. Pupation usually takes place beneath clods of earth and amongst the debris, &c., in the field.

P. ewingi occurs in Australia and Tasmania, as well as in New Zealand, and occasionally proves a pest in the former countries as it does here. Its life-history in New Zealand is but imperfectly known,

though it is usually referred to as being double-brooded, while in Australia it is described as single-brooded. In Australia eggs laid in autumn reach the pupal stage about September; from the pupal stage the adult moth emerges during the following autumn. In New Zealand the spring pupal stage lasts but a short time before the adult insect emerges, so that by the following autumn a further cycle from egg to adult is completed. The natural food of the *P. ewingi* is native grasses, but it has quickly adapted itself to imported plants, and takes readily to cereal crops to which at times it does considerable damage.

The marching habit of the pest is due to the fact that enormous numbers of larvæ are present in a limited area in which all available food is soon exhausted, so that they are forced to migrate in search of further sustenance, sometimes in hordes like an army on the march.

The reasons for an outbreak of army worms are problematical. Normally insect parasites must be largely responsible for checking undue increase of the worms, and it seems certain, therefore, that spasmodic outbreaks of the kind recently experienced are largely due to a fundamental disturbance of the host-parasite relationship, permitting a rapid multiplication of the host with a consequent relative decrease of parasites.

Other natural checks include bacterial and fungous diseases, and birds. Normally, disease probably plays a small part in keeping the pests in check, though it may prove a valuable ally in helping to exterminate them when they are assembled in large numbers. The value of birds in helping to maintain the normal balance is little understood, though birds that are chiefly insectivorous should undoubtedly be encouraged.

Control.

When the caterpillars are on the march a useful method in helping to check them is to plough a deep clean furrow across their line of advance. The furrow should be cut with the steep side nearest the crop it is intended to save. Veitch (1933) states that the best procedure in applying this method is to open the furrow, throwing the loose earth towards the area to be protected, a return furrow can then be cut into this leaving a line of loose earth above a steep face. The final shaping of the trench formed can be completed with a spade. Small vertical-sided pits should be sunk in the furrow at distances of 20 ft. to 50 ft. or more; into these the roaming caterpillars will readily fall, and may there be disposed of by means of pounding with a piece of timber or ram-rod. In connection with the furrow method of checking an advance, the use of poisoned baits should be resorted to. In the case of an outbreak of the caterpillars in a standing crop, the poison bait method is really the only suitable method of control to adopt. A mixture most commonly recommended consists of 25 lb. of bran; 1 lb. of one of the following: Paris green, sodium fluoride, sodium arsenite, white arsenic; molasses 1 to 2 quarts. To prepare, the poison and bran should be mixed in a dry condition and stirred very thoroughly to ensure an even distribution. The molasses should be dissolved in about 2 gallons of water which is then added gradually to the bran until the mixture is thoroughly damped but not too wet. It should be moistened sufficiently to have the consistency of a crumbly mash. Where sodium arsenite or sodium fluoride is used it is advisable that it be dissolved in the water to which the molasses is subsequently

added, and the whole then poured on to the requisite amount of bran, taking care as before to avoid making it too moist. The quantity of mixture required depends on the density of the infestation. In a light infestation, 8 lb. to 10 lb. of the bait per acre scattered at dusk should be sufficient, though in dealing with a heavy attack 40 lb. to 50 lb. to the acre may be necessary. The material should be broadcasted in the late evening or at dusk, as if distributed in the daytime it tends to dry out and is far less palatable to the caterpillers. Great care must be exercised in the preparation of these baits as the poisons used are extremely dangerous. To avoid inhaling the dust it is advisable to tie a handkerchief over the nose and mouth during mixing operations. Again, it is unwise to allow the poison to come in contact with the skin, though in broadcasting operations this is unavoidable. But thoroughly washing the hands and arms in a plentiful supply of fresh water will obviate any risks from its use.

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FERTILIZER IMPORTATIONS: DECEMBER QUARTER.

FOLLOWING are particulars (in tons) of fertilizers imported into New Zealand during the three months ended December, 1933: *Rock phosphate:* Nauru/Ocean Islands, 41,686. *Phosphatic guano or soft phosphate:* Seychelles Islands, 11,317; Madagascar, 3,658; New Caledonia, 527; United Kingdom, 5. *Other phosphates:* Egypt, 350. *Kainit:* France, 5; Germany, 60. *Muriate of potash:* France, 15; Germany, 20. *Sulphate of potash:* France, 110; Germany, 135. *Other Potash fertilizers:* France, 198; Germany, 246; Netherlands, 1; Spain, 100. *Sulphate of ammonia:* United Kingdom, 455; Canada, 100. *Nitrate of soda:* Chile, 165. *Other fertilizers:* United Kingdom, 1 cwt.; Germany, 20 cwt.

FARM PRODUCTION, 1932–33.

THE following information relative to farm production has been compiled by the Census and Statistics Office:—

The value of agricultural production in 1932–33 (£8,900,000) shows an increase of £900,000, or approximately 11 per cent., as compared with 1931–32. The wheat harvest of 1932–33 totalled 11,000,000 bushels as compared with the abnormally low figure of 6,500,000 bushels in the previous season; so that, notwithstanding a decrease in prices, the total value of the wheat crop increased. Increases in the yield of other important crops, notably oats, were also recorded.

Pastoral production during the 1932–33 season is valued at £20,400,000, an increase of 5·7 per cent. over the exceptionally low figure recorded in 1931–32. The volume of wool production increased from 282,800,000 lb. in 1931–32 to 288,400,000 lb. in 1932–33, while production and exports of beef, lamb, and pork were in excess of the totals for the preceding year. Prices of both wool and meat remained at extremely low levels during the season, the recovery in prices at present in progress commencing practically at the close of last production year.

The value of dairy production was practically the same as in the previous year, a considerably increased volume of butter and cheese production counteracting the effect of a fall in prices as compared with 1931–32.

The total value represented by the three groups of farm production was £52,500,000, as compared with £50,400,000 in 1931–32 and £83,400,000 in the peak year (1928–29).

CONTROL OF ORCHARD DISEASES AND PESTS BY SPRAYING.

Horticulture Division.

THE commercial fruitgrowing areas of New Zealand show wide differences in climatic conditions, vigour of trees, and susceptibility of varieties to disease. For this reason it is not possible to present an orchard-spraying programme which will be applicable throughout, and the recommendations here given may require modification to meet local requirements.

Recent investigations conducted at the Plant Research Station, Palmerston North, have so increased our knowledge concerning the physical and chemical properties of sprays, and their application, that very material alterations in our orchard-spraying programme have become necessary. The time is therefore opportune for publication of a statement of our current knowledge of the practice of spraying.

There is a distinct trend on the part of overseas manufacturers to bring forward numerous new brands of orchard sprays or spraying materials. These should be regarded with caution until their efficacy has been demonstrated.

Sprays to use.

SULPHUR.

Sulphur is recommended for the control of powdery mildew of apple trees, of mildews generally, and rusts.

Repeated trials have shown that the only satisfactory sulphur to employ as an orchard spray is colloidal sulphur. This, when used alone, is recommended at from 2 to 4 lb. per 100 gallons of water; and, when combined with lime-sulphur, at 2 lb. per 100 gallons. Commencing at petal-fall, this spray should be applied throughout the season at the periods indicated in the spraying schedules for pome and stone fruits on pages 215 and 216.

LIME-SULPHUR.

This is a dual-purpose spray, since it may be used either as a fungicide or as an insecticide. At the recommended concentrations it may be used as a winter, spring, or summer spray.

A winter application may be applied to deciduous trees at a concentration of 0·5 per cent.; but this is not recommended, as better results are to be secured by a bordeaux mixture application for the control of fungous diseases, or a winter oil for insect pests. As a spring application, apply a 0·2-per-cent. concentration at open-cluster for the control of black-spot, powdery mildew, and also diseases of stone fruits. A table of dilutions appears on page 210.

For summer use on both pome and stone fruits apply several sprays at a concentration of 0·1 per cent. and 0·083 per cent. (the weaker concentrations for stone fruits and less tolerant apple varieties), applications to be made at a ten-day interval following the petal-fall application, and afterwards at fourteen to twenty-one day intervals.

Table of Lime-sulphur Dilutions.

Polysulphide Content of the Concentrate in Percentages W/W.*	Volume of Concentrated Lime-sulphur required to prepare 100 Gallons of Spray containing a Polysulphide Content of											
	1 per Cent.		0·5 per Cent.		0·2 per Cent.		0·1 per Cent.			0·083 per Cent.		
	Gal.	pt.	Gal.	pt.	Gal.	pt.	Gal.	pt.	oz.	Pt.	oz.	
8	12	4†	6	2	2	4	1	2	0	8	6	
9	11	1	5	4½	2	1¾	1	0	18	7	8	
10	10	0	5	0	2	0	1	0	0	6	13	
11	9	0	4	4	1	6½	0	7	4	6	0	
12	8	2½	4	1	1	5¼	0	6	13	5	10	
13	7	5½	3	6¾	1	4¼	0	6	3	5	2	
14	7	1	3	4½	1	3½	0	5	14	4	15	
15	6	5	3	2½	1	2½	0	5	7	4	9	
16	6	2	3	1	1	2	0	5	0	4	3	
17	5	7	2	7½	1	1½	0	4	14	3	18	
18	5	4	2	6	1	1	0	4	9	3	14	
19	5	2	2	5	1	0½	0	4	4	3	10	
20	5	0	2	4	1	0	0	4	0	3	5	

* Taken to the nearest whole number. Thus 10·35 = 10 per cent., 10·60 = 11 per cent. This table is applicable only when the polysulphide content has been given in percentages by weight.
† Given in Imperial gallons, pints, and fluid ounces.

To prepare 100 gallons of spray, half fill the spray tank with water, add the required volume of concentrated lime-sulphur, then fill the tank to the 100 gallon mark. To prepare a small quantity of spray, as 4 gallons (the capacity of a benzine tin), multiply the number of *pints* by 20 and divide by 25. This will give, in *fluid ounces*, the required quantity of concentrated lime-sulphur.

The summer applications will hold in check black-spot and other major diseases of pome fruits (when mildew is prevalent the addition of colloidal sulphur is recommended), and brown-rot and leaf-rust of stone-fruits.

The concentration of a lime-sulphur should be measured by its polysulphide content.

Lime-sulphur is recommended as a general fungicide for applications to plants during the growing season, a safe concentration for most purposes being 0·1 per cent.

As an insecticide lime-sulphur will hold in check scales, red mite, pear leaf blister-mite, &c.

Bordeaux Mixture.

Two formulæ are recommended: Winter strength, 5–4–50; summer strength, 3–4–50.

As a foundation spray for the control of fungous diseases of pome and stone fruits, bordeaux 5–4–50 is recommended in preference to

lime-sulphur at 0·5 per cent. concentration. Application should be made at tight-cluster on pome fruits and at bud-movement on stone fruits.

For the control of leaf-curl of stone fruits two applications of bordeaux 3–4–50 are recommended, (1) when the buds begin to swell, and (2) about ten days later.

For fungous diseases of pears, citrus, tomatoes, potatoes, and most vegetables bordeaux 3–4–50 may be used during the summer months.

Bordeaux mixture should be prepared in the following manner: Fill the spray tank three parts full with water; dissolve the required quantity of copper sulphate in water (3 or 5 lb. for each 50 gallons of water), add to the tank, and start the agitator running. The copper sulphate may be dissolved with rapidity if hot water is used (5 lb. will go into solution in a minute or so in 1 gallon of boiling water), or, if first powdered may be added directly to the spray tank. Alternatively, it may be placed upon the strainer covering the intake, so that the incoming stream of water carries the particles into the tank, in which case it will go into solution within two minutes. When the dissolved copper sulphate has been added, weigh out the required quantity of commercial hydrated lime (4 lb. for each 50 gallons of water), mix to a thin paste with cold water, and with the agitator still running pour slowly into the tank, at the same time filling the tank to its capacity. Keep the agitator running for a further few minutes, and the spray is then ready for application.

The hydrated lime must be of good quality, containing not less than 90 per cent. of $Ca(OH)_2$; if the content is less than this, adjustment must be made accordingly.

Burgundy Mixture.

Burgundy is a somewhat inferior substitute for bordeaux. In burgundy 5 lb. of washing soda is used in place of each 4 lb. hydrated lime in bordeaux. Burgundy may be used on tomatoes or potatoes, provided the spray is not mixed with nor applied with arsenate of lead. Comparable concentrations with bordeaux may be used and at similar times of application.

Arsenate of Lead.

This spray is recommended for the control of chewing insects such as codling-moth, leaf-roller caterpillar, bronze beetle, pear-slug, &c. A dosage of $1\frac{1}{2}$ lb. (powder) or 3 lb. (paste) to 100 gallons of water is recommended.

For codling-moth the first spray should be applied at petal-fall, and subsequently at three-weekly intervals until the end of January.

For the control of leaf-roller caterpillar the codling-moth control sprays should be continued later into the season on late varieties of apples. Applications are often discontinued too soon to obtain satisfactory control of the caterpillar.

Bronze beetle may be controlled by this spray, provided the fruit is kept well covered with arsenate while the beetle is active. Cultivation up to the orchard boundary, completed by the beginning of November, will materially assist in the control of this pest.

Nicotine.

Nicotine at a concentration of 95 per cent. and nicotine-sulphate (nicotine content 40 per cent.) have been used for a number of years in New Zealand in combating soft-bodied insect pests. When used alone these sprays are more costly than and inferior to summer oils

STAGES OF APPLE-BLOSSOM DEVELOPMENT.

(1) Green-tip; (2) tight-cluster; (3) open-cluster; (4) pink; (5) full-bloom; (6) petal-fall; (7) calyx-closed.

[*Drawing by N. J. Adamson.*

for outside use. In confined spaces, however, such as glasshouses nicotine has proved an effective controllant of white fly, green aphis, &c. Nicotine or nicotine sulphate is applied outdoors at a concentration of 0·05 per cent., and under glass at a concentration of 0·04 per cent. To

prepare a nicotine spray in accordance with this recommendation (i) to obtain a 0·05-per-cent. concentration use nicotine at 1–1900 ($\frac{2}{5}$ pint approximately to 100 gallons), or nicotine sulphate 1–800 (1 pint to 100 gallons); and (ii) for a 0·04-per-cent. concentration use nicotine at 1–2400 ($\frac{1}{3}$ pint to 100 gallons), or nicotine sulphate 1–1000 ($\frac{4}{5}$ pint to 100 gallons). When used alone add soap at rate of 4 lb. to each 100 gallons of spray. Do not use soap when nicotine sprays are combined with lime-sulphur, lead arsenate, or bordeaux.

Oils.

Oil sprays differ in constitution, according to whether they are prepared for winter or for summer use; consequently it is necessary to recognize two types—winter oils and summer oils. If winter oils are applied during the growing season serious injury may follow, even when they are used at such low concentrations as 0·5 per cent. The oils for winter and summer use should therefore be of the type recommended and be applied at the following concentrations:—

Winter Oils.—Recommended for the control of woolly aphis and scale insects of pome and stone fruits. Apply during the dormant period to stone fruits, and not later than bud movement to pome fruits.

For woolly aphis, lecanium scale, and mussel scale of apples and pears, apply at 3 per cent. concentration (see table of dilutions on page 214). For San Jose scale of both pome and stone fruits apply a 5-per-cent. concentration.

Summer Oils.—For red mite two applications of a summer oil at a concentration of 1 per cent. to 2 per cent. are recommended; the first application to be made at mid-February, the second about ten days later. At least fourteen days should be allowed to elapse before applying an oil spray following a sulphur or lime-sulphur spray. If the foliage is in poor condition the period should be extended to four weeks.

For black and green aphis and cherry slug of stone fruits apply a 1-per-cent. concentration when the pests become noticeable.

A 1·5-per-cent. concentration is recommended against apple leaf-hopper, application to be made after mid-January when the nymphs appear.

For red and black scales of citrus two applications of 2½ per cent. summer oil at an interval of fourteen to twenty-one days during the early summer or autumn, is recommended.

Method of Preparing Oil Spray.

Stir the oil in the drum. Then pour out the required quantity into a clean mixing vessel. Add slowly water* equal to the volume of oil. Stir thoroughly (or, better still, pump the mixture vigorously through a hand pump for several minutes), when an emulsion free from lumps and free oil should result. The spray tank and pump should be thoroughly washed out to remove the residue of previous sprays, such

* If the water is hard add washing soda at the rate of 1 lb. to 100 gallons water. If this quantity is not sufficient add just sufficient additional washing soda to bring about a complete emulsion.

as lime-sulphur and bordeaux. While the required quantity of water is being run into the tank, with the agitator running, add slowly the prepared emulsion. A spray in which free oil is present should not be used until the free oil has been emulsified. This can usually be readily done if free oil appears by the addition of about 1 lb. of washing soda to each 100 gallons water if the above directions have been observed.

Table of Oil Dilutions.

(To prepare 100 gallons of spray of the required concentration, add the quantity of oil given in the upper figure to the volume of water specified in the lower figure.)

Oil Content in Bulk Supply, in Percentages.	Percentage of Oil Concentration required.					
	10.	5.	4.	3.	2.	1.
100	10·0 90·0	5·0 95·0	4·0 96·0	3·0 97·0	2·0 98·0	1·0 99·0
95	10·5 89·5	5·3 94·7	4·2 95·8	3·1 96·9	2·1 97·9	1·05 98·95
90	11·1 88·9	5·5 94·5	4·4 95·6	3·3 96·7	2·2 97·8	1·11 98·89
85	11·7 88·3	5·8 94·2	4·7 95·3	3·5 96·5	2·3 97·7	1·17 98·83
80	12·5 87·5	6·25 93·7	5·0 95·0	3·75 96·25	2·5 97·5	1·25 98·75
75	13·3 86·7	6·7 93·3	5·3 94·7	4·0 96·0	2·7 97·3	1·33 98·67
70	14·3 85·7	7·1 92·9	5·6 94·4	4·3 95·7	2·8 97·2	1·42 98·58
65	15·4 84·6	7·7 92·3	6·1 93·9	4·6 95·4	3·1 96·9	1·53 98·47
60	16·7 83·3	8·3 91·7	6·7 93·3	5·0 95·0	3·3 96·7	1·66 98·34
55	18·2 81·8	9·1 90·9	7·3 92·7	5·4 94·6	3·6 96·4	1·81 98·19
50	20·0 80·0	10·0 90·0	8·0 92·0	6·0 94·0	4·0 96·0	2·0 98·0
Empirical formula*	1–10	1–20	1–25	1–33	1–50	1–100

* Based on the assumption that all oils are of 100 per cent. concentration.

These figures are taken to the nearest fraction. In using the table the orchardist has but to ascertain the quantity of spray his tank holds and to add the required proportion of water, then the oil in the form of a cream-like emulsion. It is sufficient to take the oil to the nearest quarter gallon (save in the greatest dilutions) and the water to the nearest whole gallon.

Combination Sprays.

In order to reduce the number of applications certain combination sprays may be employed with advantage, provided the following precautions are observed :—

Lime-sulphur and Lead Arsenate.—Fill the tank with water and to this add the required volume of lime-sulphur. To the required quantity of lead arsenate add three times its weight of hydrated lime, mix with water to form a thin paste, and pour it into the spray tank while the agitator is running. Apply as rapidly as possible after mixing.

Lime-sulphur plus Colloidal Sulphur.—To a 0·1-per-cent. concentrate of lime-sulphur add 2 lb. of colloidal sulphur. This combination is safer to apply and more effective than either spray used alone, and is recommended for the control of powdery mildew and black-spot of apples, brown-rot and leaf-rust of stone fruits, &c.

Summer Oil plus Nicotine.—One application of this combination, in which nicotine 95 per cent. at concentration of 0·04 per cent. (1–2500) or nicotine sulphate 40 per cent. at the same concentration (1–1000), is added to a summer oil at 1-per-cent. concentration, is almost as effective as, though more expensive than, two summer oil sprays, and considerably more effective than nicotine used alone.

Spray Schedule for Pome Fruits.

Period of Application.	Treatment.	Disease or Pest.
(1) Bud-movement ..	Winter oil 3 per cent. to 5 per cent.	Scales and woolly aphis (5 per cent. for San Jose scale).
(2) Green-tip	Bordeaux mixture 5–4–50, or lime-sulphur 0·5 per cent.	Black-spot.
(3) Tight-cluster* ..	Lime-sulphur 0·2 per cent.	Black-spot, powdery mildew.
(4) Pink	Lime-sulphur 0·1 per cent.	Black-spot, powdery mildew.
(5) Petal-fall	Lime-sulphur 0·1 per cent., plus colloidal-sulphur 2 lb., and lead arsenate (1½ lb. in 100 gallons spray)	Black-spot, powdery mildew, codling-moth, bronze beetle.
(6) Ten days later ..	Repeat petal-fall spray	
(7) Fourteen to eighteen days' intervals up to mid-December	Repeat petal-fall spray	
(8) Subsequently at fourteen- to twenty-one-day intervals till mid-January, and later as required	Lime-sulphur 0·083 per cent., plus colloidal-sulphur 2 lb., and lead arsenate (1½ lb. in 100 gallons spray)	Black-spot, powdery mildew, codling-moth, leaf-roller caterpillar.
(9) Between mid-January and beginning March†	Summer oil 1 per cent. to 2 per cent. Two applications at ten-day intervals†	Red-mite, scales, woolly aphis.

* On pears bordeaux 3–4–50 is recommended from this period onwards.
† Do not apply until fourteen days have elapsed preceding or following sulphur or lime-sulphur sprays.

Apple leaf-hopper may be combated by a 1·5-per-cent. summer oil application when nymphs appear after mid-January; or, alternatively, a nicotine sulphate spray (1–800) may be applied.

Spray Schedule for Stone Fruits.

Period of Application.	Treatment.	Disease or Pest.
(1) Dormant	Winter oil 3 per cent. to 5 per cent	Scales (5 per cent. for San Jose scale).
(2) Bud-movement of blossom buds	Bordeaux mixture 5–4–50	Leaf-curl, shot-hole, bladder-plum.
(3) Early pink* ..	Bordeaux mixture 3-4-50, or lime-sulphur 0·2 per cent.*	Leaf-curl, brown-rot,* shot-hole.
(4) Petal-fall	Lime-sulphur 0·083 per cent., plus colloidal-sulphur (2 lb. to 100 gallons spray)	
(5) One month after petal-fall	Repeat No. 4	Brown-rot, shot-hole, leaf-rust
(6) Seven weeks after petal-fall	Repeat No. 4	
(7) Five weeks prior to anticipated first picking	Repeat No. 4	
(8) Three to two weeks later	Repeat No. 4	

* If season favourable to brown-rot development, apply an additional spray of 0·1-per-cent. lime-sulphur when majority of buds are at the pink stage.

When black and green aphis are prevalent, apply a 1-per-cent. summer oil, and follow with a second if after four to five days viable insects are noticeable.

For leaf-roller caterpillar on plums and cherries apply 1 lb. lead arsenate, plus 3 lb. hydrated lime per 100 gallons. On peaches, nectarines, and apricots use one or two 1-per-cent. summer oil sprays, as these plants will not tolerate arsenates.

Spreaders.

Reference to the use of spreaders has been omitted, since their usefulness when combined with lime-sulphur and sulphur sprays is doubtful, and also on account of arsenates frequently having spreaders incorporated in them.

Treatment of Tree Wounds and their Sterilization.

It is very necessary that tree wounds should receive proper attention to prevent bacteria or the spores of fungi gaining entrance through the exposed tissues. Remove diseased or damaged tissues and sterilize the wounds. The work should be done thoroughly, for if infected tissue remains the disease may again become active.

Acidulated mercuric chloride on the basis of the following formula is recommended for sterilizing: Mercuric chloride, 1 gramme ($\frac{1}{28}$ oz. avoirdupois approximately); hydrochloric acid, concentrated, 15 c.c. ($\frac{1}{2}$ fluid oz. approximately); water, 1,000 c.c. (36 fluid oz. approximately).

To prepare the solution dissolve the mercuric chloride in the acid, then add the mixture carefully to the water. Mix thoroughly before use. Metals should not be allowed to come into contact with the solution. Mix in porcelain or enamelware container, and store in a glass-stoppered bottle. The mixture is poisonous, and should be labelled "Poison—not to be taken."

The mixture can be made up in stock solution by adding 20 grammes ($\frac{5}{7}$ oz. avoirdupois approximately) of mercuric chloride to 300 c.c. (11 fluid

oz. approximately) of commercial concentrated hydrochloric acid. To use, dilute one part of this stock solution with 60 parts of water. Keep in a glass container and label as poison.

When the wound is dry, protect with coal tar or thick white lead paint.

Bordeaux Paste.—Made according to the following formula, this is often recommended for treatment of wounds on citrus caused by the bark-blotch organism and collar-rot: Copper sulphate, 1 lb.; hydrated lime, 2 lb.; water, 1·5 gallons.

To prepare, dissolve the copper sulphate in half the quantity of water, and add the remainder to the lime. Stir the lime mixture into a stiff paste, at the same time slowly adding the copper sulphate solution. When mixed it has the consistency of treacle. Apply with a stiff brush.

THE PIG INDUSTRY AND FEED-SUPPLIES.

HOW FAR THE PRACTICE OF DENMARK APPLIES TO NEW ZEALAND.

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In most discussions about the pig industry comparisons are made between Denmark and New Zealand, and generally it is concluded that New Zealand can develop pigs on the same extensive and profitable lines as Denmark has done. The common view is summed up in the following sentence: "New Zealand cannot produce grain at world prices, and as Denmark is similarly placed, she has to import the grain she requires for stock foods, which could be done by New Zealand just as cheaply."

A review of Denmark's production figures and market returns creates some doubt as to the accuracy of the statement.

Production of Feed.

Relative to production of feed, from page 171 of the handbook "Denmark," 1931, the information contained in Table 1 is extracted.

Table 1.—Areas in Different Crops in Denmark in the Years indicated.

Crop.	1881.	1896.	1912.	1928.	Percentage of Area devoted to each Crop in 1928.
Grains	1,251*	1,316	1,286	1,380	47
Roots and potatoes ..	71	157	389	550	18½
Grass and green fodder ..	1,069	1,090	946	906	31
Other crops (seed) ..	74	38	33	34	1
Fallow	295	309	228	76	2½
Total areas ..	2,758	2,910	2,892	2,945	..

* Areas given in thousands of hectares. One hectare equals 2½ acres approximately.

From a study of this table it is evident that Denmark is largely a grain-producing country, but she has made only a slight increase in the area devoted to grain during the last fifty years. Forty-six per cent. of arable area is under grain crops.

Prior to 1880 (page 170*) the value of Denmark's grain exports totalled about 60 per cent. of the whole agricultural export, but the low grain prices in the "eighties" and "nineties" compelled the Danish farmers to change from grain-production to animal husbandry (page 71).

Owing to better cultivation, to the use of fertilizers, and to better strains of crops, yields have been greatly increased. These are set out in the following table (page 172).

All crops are included for reference later.

Table 2.—Yields of Stock Feeds, in Millions of Quintals of Feed Units.

(1 quintal of feed units = 100 kilos or 220 lb. of barley.)

Kind of Feed.	1880–84.	1895–99.	1910–14.	1928–29.
Grain	18·4	19·8	22·5	35·1
Straw	5·2	5·6	6·6	11·3
Roots	1·8	5·9	18·6	29·4
Hay	4·0	6·3	6·9	5·6
Grass and green fodder	11·1	12·4	15·0	23·0
Imported grain	0·2	5·6	7·7	12·1
Skim milk	1·9	2·8	5·0	7·0
Total	42·6	58·4	82·3	123·5

From this and the preceding table it will be seen that since 1880, when Denmark found she could not sell grain as such on the world's market, she has doubled her production of grain and trebled her production of feed without any appreciable increase in total area under cultivation. These two tables should dispel the idea that Denmark is not a grain-producing country. They should also make it clear that she produces, along with grain, an abundance of other feed.

Utilization of Feed produced.

Consideration of how this feed-supply is used should help to prevent the drawing of further erroneous conclusions about Denmark. The following table sets out the amounts of feed required for different purposes. These are taken partly from the handbook "Denmark, 1931," otherwise they are calculated on internationally accepted standards.

Table 3.—Feed required for Different Purposes.

Stock (Thousands).	Feed Units. Millions of Quintals per Year.
Dairy cows, 1,579, maintenance at 4 feed units per day ..	23·0
Produce, 5,050 million kilos milk at 0·4 feed unit per kilo ..	20·2
Other cattle, 1,452 at 4 feed units per day	21·0
5,350 pigs, killed (190 lb. live weight), 2 feed units to produce 100 lb. live weight (fed from 26 lb. to 190 lb.) plus 30 per cent. for breeding stock	22·8
Bedding as straw	3·0
520 horses at 9 feed units per day	17·0
200 sheep at 11 feed units per week	0·8
23,000 poultry at 35 feed units per year	8·2
For seed and human consumption	8·0
Grand total	124·0

* The pages to which reference is made herein are of the handbook "Denmark," 1931.

Feed provided in Table 2 is thus accounted for in Table 3.

In "Denmark," 1931 (page 176), the amount of feed for pigs and poultry is given at 37,000,000 quintals, but details are not given as for cows and milk-production. In Table 3 the calculated amount for pigs is 34,000,000 quintals, and of this 3,000,000 quintals is in the form of straw for bedding. Thirty-four million quintals accords better with total feed-production than 37,000,000 quintals does.

Pigs and Poultry.

Amount of Home-grown and Imported Feeds and the Returns per Ton from them.

The 34,000,000 quintals of feed could be provided reasonably from the following sources:—

Table 4.

		Million Quintals.
Bedding (straw)		3·0
Milk, 7,000,000 quintals (two-thirds for pigs and poultry)		4·6
Home-grown—		
Rye .. 2,600,000	Total grown, less 1,000,000 for seed	12·7
Barley .. 11,100,000		
Wheat offals ..		0·8
Roots or meslin		4·1
Imported—		
Wheat offals .. 700,000		
Rye .. 2,200,000	Total imports	8·8
Maize .. 5,900,000		
Total		34·0

In this total, 8,800,000 quintals of feed, out of 31,000,000 eaten, are imported grain. This is the fact that is seized on by those who make the statement that Denmark's pig industry depends on imported grain. That the grain is used for pigs and poultry is admitted, but this in no way proves that the pig industry has developed because of imported grain. It may be that the poultry industry has developed. The reverse, that imported grain has come in because these industries were profitable, is more probably the case. Any animal project is profitable when feed costs are a small proportion of the returns, and that condition obtains when grass or roots are largely used as with sheep and dairy cows in New Zealand. Grass or roots cost per feed unit from one-eighth to one-sixth of what grain does. Table 4 shows that roots may constitute 20 per cent. of pig-feed used in Denmark. (This amount could well be used for sow maintenance.) There is a certainty that the use of roots has been a factor of considerable importance in the development of the Danish pig industry.

A matter of importance in the use of grain is the value of produce sold.

Denmark exports £20,000,000 sterling worth of bacon, and this on the basis of 5,350,000 carcasses (pages 71, 72) each of 140 lb. dead weight is equivalent to a price of 6·4d. per pound. Denmark exports cured bacon, however, and if the usual allowance of 30 per cent. of offals in bacon-curing is made, the price of cured bacon is about 9d. per pound.

Feed used is about 23,000,000 quintals, consequently the gross return to Denmark is about £9 per ton of feed units: net return—*i.e.*, price feeder could pay landed on the farm—would be approximately

75 per cent. of this—*i.e.*, £6 15s. The question arises whether New Zealand could do this. If we exported the same number of pig carcasses as Denmark does and received 6·4d. per pound in London, the total value would be £20,000,000 sterling. But export charges at 2½d. per pound amount to £7,800,000 sterling, so that the return to New Zealand farmers would be £12,200,000 sterling.

This would be about £6 gross per ton for feed unit used. Corresponding net return or price payable by the feeder would be £4 10s. If we exported Denmark's quantities and got 4½d. per pound in London the total value would be £14,000,000 sterling. Export charges would be still £7,800,000 sterling, and the return to New Zealand farmers would be £6,200,000 sterling, or about £3 gross per ton of feed units. This is equivalent to about 10s. per ton of mangels (6 ton mangels=1 ton feed units), 1s. 6d. per bushel of wheat, 1s. 4d. per bushel of barley, and so on.

New Zealand can produce crops of grass and roots at less than £3 per ton of feed units, but she can neither produce nor import grain at this price. When we have copied Denmark by growing abundance of cheap fodder, the pig industry will develop, and, because of profits made on these home-grown bulk feeds, we will be able to use grains either bought or home-grown. It will then be possible to use grain at higher prices than are now paid for it.

Increasing Export Value by Manufacturing in New Zealand.

In the case of pigs it has been shown that when London prices are 4½d. per pound and export charges are 2½d. per pound the New Zealand value of Denmark's produce is £14,000,000 sterling, of which £7,800,000 sterling is spent in putting it on the London market, and £6,200,000 sterling is returned to farmers. It would benefit New Zealand to retain more of the £14,000,000 sterling, and this could be done by in some way processing the carcasses so as to increase the value per pound of the weight exported, thus reducing the proportion of their value absorbed by freight to £5,500,000.

Even though the foregoing information had countered the suggestions, (1) that Denmark is not a grain-growing country, (2) that her pig industry has been built up on imported grain, and (3) that if Denmark is able to import grain New Zealand can do the same, there still remains an impression at the back of most people's minds that grain is essential to the pig industry. This is firmly established because of the undisputed improvement in the dietetic value of milk when grain is used with it and because of the improvement in carcass quality where grain is used. There is a possibility that the use of a small quantity of grain with milk might be worth while. The possibilities of using different proportions of grain at different prices are explored in the following paragraphs.

The importance of pigs in New Zealand is bound up with the dairy industry, and the cash returns per cow must be the yardstick by which the condition of the industry is measured. Too often comparisons are made between Denmark, where returns as high as £20 per cow (9·6d. per gallon for 500 gallons) are obtained, and ourselves where returns from £2 up to £5 per cow are obtained (0·96d. to

2·4d. per gallon for 500 gallons). These low returns on our part are not the result of inefficiency on the part of the farmer, nor of inability on his part to compound rations capable of high production. Low returns are entirely a question of costs of feed used and selling-price of pork, and if our prices for these two commodities were the same as those ruling in Denmark, then we would be able to get as good returns as the Danes. Some will say that our returns for pork are only about 2d. per pound below the return obtained by the Danes, and, such being the case, that our returns per cow should be two-thirds or five-sevenths that of the returns obtained in Denmark, when our prices are 2d. less than theirs.

Unfortunately this is not so, and an increase in price of 2d. per pound of pork increases the return per gallon of milk in an extraordinary way, depending on the proportion of grain and skim milk that are fed. (See Table 5.)

There is a very well-defined and sensitive balance—*i.e.*, suddenly changing—between pork prices, grain prices, and returns per gallon of milk. The less grain used the less sensitive the change, and the less is the maximum return obtainable for milk when grain is cheap and pork is dear.

Table 5 sets out the gross returns obtained per gallon of milk with different classes of feeding at different prices of pork and different costs of feed.

The process of arriving at these returns per gallon is as follows:—

(*a*) Definite quantities of milk or milk and grain are required to produce a fixed quantity of live weight (100 lb. equal to 70 lb. of pork).

(*b*) One hundred pounds of live weight (equal 70 lb. of pork) returns 280d. at 4d. per pound, 350d. at 5d. per pound, and so on.

(*c*) The cost of grain used is deducted from this amount, and whatever is left is credited to the milk. This amount divided by the gallons of milk used gives the gross return per gallon.

If it is desired to make the comparison on the basis of net returns, that is, deducting labour, overhead, cartage, commission, &c., a deduction of about 1½d. per pound of carcass should be made. This will reduce the returns per gallon of milk in paragraph (*a*) by 0·28d. per gallon, in paragraph (*b*) by 0·36d. per gallon, in paragraph (*c*) by 0·66d. per gallon, and in paragraph (*d*) by 2·10d. per gallon. It is debatable whether the gross or net returns should be used, since the lower net returns are offset by the fact that the feeder had received wages which, without pigs, he would not receive.

Where the figures are in heavy type the gross return from skim-milk are less than those from milk used alone—*i.e.*, the use of grain is unprofitable at those prices for grain and pork.

Para. (*b*) of the table shows that where a little grain is used with skim-milk the returns for milk are little different from those where milk is used alone. When there is a loss it is so small that it is not noticeable, and consequently farmers have used grain with milk in this way even when grain was £12 per ton.

Para. (*c*) shows that grain used in this way gives wider variations in the returns for skim-milk and sufficient losses at low pork prices and high grain prices to prohibit the use of grain in these proportions by New Zealand farmers.

Table 5.—Showing Returns per Gallon of Milk in Pence, with Specified Variations in Price of Grain and Pork.

Paragraph.	Ration used to produce 100 lb. Increase in Live Weight.	Price of Grain per Short Ton.	Price of Pork per Pound, in Pence.						
			4d.	5d.	6d.	7d.	8d.	9d.	12d.
(*a*)	Milk alone (380 gallons)	..	0·74	0·92	1·11	1·29	1·48	1·66	2·22
(*b*)	80 lb. meal.. 290 gal. milk.	£ 6	0·77	1·01	1·25	1·49	1·73	1·97	2·69
		9	**0·67**	**0·91**	1·15	1·39	1·63	1·87	2·59
		12	**0·57**	**0·81**	**1·05**	**1·29**	1·53	1·77	2·49
(*c*)	200 lb. meal 160 gal. milk.	£ 6	0·85	1·28	1·72	2·15	2·59	3·02	4·32
		9	**0·40**	**0·83**	1·27	1·70	2·14	2·55	3·87
		12	**−0·05***	**0·38**	**0·82**	**1·25**	1·69	2·10	3·42
(*d*)	300 lb. meal 50 gal. milk.	£ 6	1·28	2·68	4·08	5·48	6·88	8·28	12·48
		9	**−0·88***	**0·52**	1·92	3·32	4·72	6·12	10·32
		12	**−3·04***	**−1·64***	**−0·24***	**1·16**	2·56	3·96	8·16

Returns per gallon of milk, in pence.

* An actual loss of this amount per gallon.

Para. (*d*) shows that grain used in this way gives still wider variations in the returns for skim-milk. When pork prices are high the returns from skim-milk are very profitable, but if pork prices are low and grain prices are high the loss on milk is great. This is apparently the way grain is used in Denmark, where about one-fifth of the pig-feed supply is milk. In order to consume the same milk-supply with much grain, as here, approximately eight times as many pigs have to be used as when no grain is used. If grain were procurable at £6 per ton the New Zealand pig-farmer would treble his return per gallon of milk when pork is 5d. per pound—*i.e.*, he would be getting the returns from three pigs and paying out the returns for the other five to the grain-producers. Few farmers would undertake such a philanthropic project.

Those who seek to develop the pig industry may have in mind less ambitious schemes than increasing the pig numbers by eight times. A perusal of Bulletin No. 17 of the Department of Scientific and Industrial Research, containing a statement by F. R. Callaghan, on supply of pig feed in the Dominion will show that there is available sufficient feed to produce four and a half times as many pigs as we now produce. This should set their minds at rest as to the necessity of imported grain in the development of the industry.

Possible Lines of Development of the Pig Industry.

Mr. A. H. Cockayne has repeatedly pointed out that the dairy industry has developed chiefly because of (1) home separation, (2) top-dressing, (3) better strains of grass, (4) winter-feed conservation, (5) rotational grazing, and (6) herd-testing. All these practices have

such obvious advantages that dairy-farmers could not afford to ignore them, consequently they have been widely adopted, with the result that the industry has prospered. The pig industry will develop similarly when the pig-farmer has placed at his disposal advantages that he cannot afford to ignore. The introduction of imported grain cannot be such an advantage.

Feeding-trials and pig-recording have shown that there are a number of practices that can be adopted with advantage. These are as follows:—

(1) The use of some nitrogenous food supply (meat meal) with present winter feeds so as to carry store pigs through the winter in a fit condition. When this is done two litters per sow can be reared each year, thus increasing our output of pigs by 40 per cent. The use of meat meal with winter feeds when no milk is available for store and breeding stock almost trebles the feeding-value of roots and other winter feeds. (See results of feeding-trials conducted by Lincoln College and the Department of Agriculture.) Used along with milk, meat meal gives a better return for milk than grain does. (See Waikato pig-recording results.) Used along with whey for fattening pigs meat meal improves the return for whey by about 50 per cent. (See feeding-trials 1927–28, Lincoln College.)

(2) The adequate feeding of the sow prior to farrowing: During the last five years pig-recording in the Waikato district has effected an improvement of 30 per cent. in sow-production. Cheap weaners are vital to the industry. Better litters mean reduced overhead costs.

(3) The use of grass and roots (cheap feed) along with milk and grain: An improvement of over 20 per cent. in the returns obtained from milk used can be made when one-quarter of the pig feed is supplied in the form of grass or roots. The profitable use of grain as a pig feed can be developed only when a considerable amount of roots is used along with grain. From feeding-trial results it is calculated that the return per acre from barley alone (40 bushels per acre) is about £4 when pork is 4d. per pound. If three-quarters of the grain area were sown in grain and the other one-quarter used to grow roots (40 tons to the acre) for pig feed the return per acre would be increased to £7 10s. per acre for the whole area. The cost of growing roots is probably twice as great per acre, but the improved return by growing roots and grain on present grain areas and converting them into stock products warrants a consideration of the possibilities of pigs, especially since the returns from grain are so unsatisfactory.

(4) There is a possibility that the production of cured bacon for export may also be a factor in improving returns from pigs. If New Zealand were to export as many pigs as Denmark does, the total charges between the farm and the market would amount to just on £7,000,000 (5,350,000 carcasses of 140 lb. at 2¼d.) If these carcasses were turned into bacon the export value would be as great as that of green carcasses, but the export charges would be about 30 per cent. less.

PINK-EYE IN SHEEP.

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THE name "pink-eye" is given to an acute inflammation of the eyes of sheep and is referred to as contagious ophthalmia or contagious irido-cyclitis.

The disease makes its appearance in the hot dry weather, usually when green feed is becoming scarce. It was at one time looked upon as being due to injury to the eyes from grass-stalks or as a reaction to the pollen of certain grasses, much as asthma occurs in human beings. Both these reasons have been shown to be wrong. In South Africa a minute body invading cells and known as a "Richsettia body" is said to be responsible, but, as yet, this organism has not been found in affected sheep in New Zealand.

A considerable amount of experimental work has not thrown any very intense light on the disease. At Wallaceville, where the flock has on two occasions been visited in the last few years with pink-eye, the occasions have been in exceptionally dry seasons after pollination is over and after the grass has been topped, either for hay or by mower. The sheep are noticed to be partially blind, in that they circle round, run into fences and even run into the drover in severe cases. Usually the sheep can just distinguish an obstacle and will avoid it, but is unable to see wire fences and will run into them with considerable force. When the sheep is caught the eye is noticed to be very damp, the tears having run down the face, the cornea—outer covering of the eye—is opaque and may, where injury has occurred through running into fences, &c., have become ulcerated or show a degree of necrosis. Beneath the cornea and round the iris is seen a circle of pink, which is due to congested blood-vessels in that area, and which gives the reason for the very descriptive name of "pink-eye" to the disease.

The sheep is sensitive to light, and unless driven will keep its eyelids partly closed. If driven its head goes up in the air and the eyeballs stare sightlessly, while the sheep endeavours to follow the flock by sound. One eye is usually affected first, to be followed quickly by the second. Occasionally both become infected together. Inflammation persists for two or three weeks in severe cases.

Considerable efforts have been made to find the organism responsible for this disease. That the condition is very contagious is seen by the fact that a drop of a dilution of 1-100 of tears from an infected sheep will set up inflammation in an eye of a normal sheep in from two to three days, while the second eye becomes inflamed two days later. It is some seven days from the time of infection that the disease reaches its height. If the tears are filtered they do not cause inflammation, showing that the disease is unlikely to be due to a virus or to a chemical change of the tears themselves. Many organisms which have been grown from affected eyes do not appear harmful when introduced into normal sheep. Tears given by drenching or placed intravenously into the sheep have no effect in the few cases tried, but diluted tears poured up the nostril set up inflammation in the eye of that side.

Sheep apparently become infected from other sheep either by fly carriage or from drinking-troughs. Flies have not been seen to worry sheep at Wallaceville, except possibly a small sand-fly which gets into the corners of eyes. It is known, however, that on the last outbreak of pink-eye the neighbouring farm had the trouble before the sheep in the laboratory flock, and a watering-trough connects the two lots of sheep. The inference, therefore, is that the laboratory flock became infected from the trough.

Droving along dusty roads appears to be a method of infection, the organism being present in the dust of stock routes in certain districts, for many flocks of a certain North Island district become infected if taken out on the highway in the late summer. There is reason to believe that sheep gain a certain amount of immunity to the disease, for older sheep previously affected or flocks in which the disease frequently appears do not seem to suffer as greatly as a flock invaded for the first time. In this latter case the disease is found to affect all the sheep.

Treatment.

For the treatment of pink-eye old shepherds use a barbarous method, that of putting powdered glass or sugar in the eye, "to cut off the white" they explain. In these days one wonders at the survival of such crude treatment. There are several dressings which can be applied with advantage to the eye, the cheapest and most easily applied being—(*a*) boracic acid solution, 1 oz. to 2 pints of warm water; (*b*) zinc sulphate, 3 grains to 1 oz. of water; (*c*) argyrol, 1 part to 9 parts water; (*d*) yellow oxide of mercury, 1 in 50.

Any of these materials may be got from the chemist. The first three—(*a*), (*b*), (*c*)—should be applied to the affected eye in small quantities from a dropper, such as is used to fill fountain pens; the last one—(*d*)—can be obtained in pointed tubes from which the paste can be squeezed into the corner of the eye. Treatment may be carried out daily if suitable, or as often as possible while the eye is showing inflammation.

The act of running in the sheep for treatment, however, may far outweigh the beneficial effect of the eye lotions where the paddocks are rough, or the dogs not sufficiently under control. Blind sheep can be drafted into a small paddock where they can easily be caught for treatment. As a matter of prevention this should be done.

The inflammation passes off in about three weeks leaving the great majority of the sheep with usual eyesight. If, however, the sheep have been chased about and have had eyes injured in fences, &c., a percentage will be found blind.

Theoretically, it seems likely that there is a vitamin deficiency in the fodder of sheep in the dry season of the year which makes them susceptible to ophthalmia, so that any green feed given to an affected flock should be useful in preventing or helping to cut short an outbreak.

Cider-making.—The quantity of cider manufactured from the 1932 apple crop in New Zealand is estimated at 40,000 gallons, with a commercial value of some £10,000.

GRADING "GRAIN" IN HONEY.

W. D. REID, Mycological Laboratory, Plant Research Station, and D. S. ROBINSON, Horticulture Division, Palmerston North.

RECENTLY honey samples have been examined to determine if crystal size indicates the "grain" of a honey. The samples have been derived from different sources, graded according to the tongue test, and then microscopically examined. At the present time grain is determined by the feel of the honey on the tongue, and points are allotted according to the fineness or coarseness so estimated. A smooth honey does not exhibit any perceptible grain, whereas a coarse honey is more or less sandy to the touch. Standards comparable to these extremes do not exist. It is evident that grain is dependent in some way on the component crystals, and examinations have been made to determine if size of crystal bears any relation to the present grading system.

Different honeys contain many types of crystals, and all types may be present in one honey. The common crystal forms are small plates, fine needle-like crystals, large compact plates, or large aggregates of either plates or needle-like crystals. In size all these types vary considerably, but in the majority of honeys the predominating crystals are small plates of 14 to 20 γ by 4 to 14 γ.*

In a microscopic examination of honey it is necessary to separate the component crystals, and for this purpose the best medium is a liquid honey either from freshly capped comb or from a liquefied honey, preferably of fine grain. A saturated sugar solution is also suitable, but rapid crystal formation interferes with examination of the slides.

Two or three "pinhead" quantities of the honey to be examined are placed in a drop of the diluting honey, stirred with a sharp instrument, and covered with a cover slip. After a rapid survey of the slide the crystals can be measured by means of a scale eyepiece. For examination a 16 mm. objective and a 10 × eyepiece have provided the most suitable magnification. In the following table of results these scale readings have been converted into their equivalent values in microns. In measuring the crystals both length and breadth have been recorded, but only the mean length has been included in the table. The ratio of length to breadth is not constant for all crystal forms, but in order to simplify subsequent comparisons only the greater measurement has been considered. In measuring the aggregate masses of crystals the same procedure has been adopted. The number of readings required for determining an accurate mean has not been calculated, but after many hundreds of examinations it appears that a minimum of 42 serves for the mean crystal size for a honey, or as few as 28 for the mean of the largest crystals present. A single slide provides 14 or more of the largest crystals. It is probable that accurate

* γ = micron—approximately $\frac{1}{25000}$ of one inch.

results would require many more readings per sample, but for practical purposes a minimum consistent with the accuracy of careful tongue grading is all that is required.

The results of the investigation are given in the following table:—

RESULTS.

Number.	Columns. 1.	2. Mean of All Crystals.	3. Mean of Largest Crystals.	4. Grading Points.	
	Per Cent.	γ.	γ.		
20	100	13·0	156	15	
21	75	25·6	254	13½	
22	65	35·0	330	13½	
23	50	37·4	350	13	Group 1.
24	40	27·1	354	13	
25	30	22·7	635	12	
26	20	38·0	868	12½	
27	1	25·0	1380	10	
	Order of Grading.				
28	1	19·2	124	15	
29	2	19·6	230	14	
30	3	16·8	156	14½	
31	4	18·2	154	14½	
32	6	16·8	243	14½	
33	7	25·2	252	14	
34	8	25·2	254	14	
35	9	29·4	280	14½	Group 2.
36	10	35·8	364	13½	
37	11	21·3	420	12½	
38	12	21·0	382	13½	
39	13	49·0	322	13½	
40	15	49·0	714	12	
41	16	33·0	1036	11½	
	Grading Points.				
1	15	8·5	92	15	
10	15	9·2	96	15	
11	15	19·5	108	15	
13	14½	10·0	108	14½	
2	14½	9·9	120	14½	
8	14½	13·0	156	14½	
9	14½	11·0	164	14½	
16	14½	19·0	209	14½	Group 3.
43	14	20·0	207	14	
44	14	17·6	209	14	
3	13	27·0	348	13	
14	12½	22·0	798	12½	
45	12	27·9	625	12	
15	11	26·8	968	11	
4	10	16·5	980	10	
12	11	27·4	984	11	

EXPLANATION OF TABLE.

Column 1. The tongue grading of samples indicated by the Honey Export Control Board: In Group 1 the grading is based on 100 per cent. for finest grain and 1 per cent. for coarsest.

In Group 2 points were not allotted by the Honey Export Control Board, but the samples were in order of grading. In Group 3 points were allotted according to the present system of judging.

Column 2 gives the mean crystal size (length only), in microns.

Column 3 gives the mean crystal size (length only) of the largest crystals or aggregates in microns.

Column 4 gives the grading according to the present system. (In Group 3 columns 1 and 4 are the same.)

Discussion of Results.

The results show that a close correlation exists between the mean of the aggregate crystals and grading points. Columns 3 and 4 are also comparable, but many more exceptions occur. It is to be noted that as a general rule a large average crystal size means that large aggregates exist, but the reverse is not necessarily true.

In a few cases the microscopic measurements do not agree with the gradings. This is exemplified by comparing, in columns 3 and 4, numbers 25 and 26; 16, 43, and 44; 14 and 45; and similarly numbers 23 and 24; 37, 38, and 39, in columns 3 and 1.

It must be borne in mind that a standard of grading does not exist. Tongue testing is arbitrary, and results are liable to fluctuate from day to day, though the allocation of points in column 4 was carefully done by comparing each honey with others in the groups. Therefore it is impossible to say which column is a true representation of the grain of the honey.

The advantages and disadvantages of each system can be summarized as follows:—

Tongue Grading.

(1) Unless very careful comparisons are made this method gives different results from day to day.

(2) The allocation of points is dependent on a mental standard set up by the previous honey samples tested.

(3) The system is rapid in operation, but becomes slow as soon as accuracy is required involving comparison with samples of approximately the same grade.

Microscopic System.

(1) The measurement of the aggregates or largest crystals gives grading results comparable with careful tongue testing.

(2) The process of measuring is slow compared with normal tongue testing, requiring from five to seven minutes per sample.

(3) Errors may arise from the small sample tested—*i.e.*, the few readings taken—but the variations are much less than by tongue testing.

(4) A standard (of measurement) exists for all samples.

It will be observed from the table that the tongue is not very sensitive, for a difference of 100γ is not sufficient to separate two honeys, (see 31, 32, and 35), and, conversely, honeys of approximately the same measurement may be in three different grades (see 21, 31, and 35). On the other hand under grading conditions measurements by the microscope will not vary by more than 50γ for the same honey.

A suggestion has been made that standards be adopted for use with the present tongue grading, and for this purpose A1 sugar and Cerebos salt have been proposed. Examinations of these substances have given the following results: A1 sugar varies in size with each consignment, from 432γ to 840γ for the mean of the crystals, and from 826γ to 1030γ for the mean of the largest crystals. Similarly Cerebos salt varies from 280γ to 390γ for the mean of the largest crystals and aggregates. It is evident that the use of these substances as standards is impracticable, mainly because they vary in particle size and partly because their texture is not comparable with that of honey.

Conclusion.

The determination of the average length of the largest crystals or aggregates of honey provides a system of grading honey grain which is more accurate than the present tongue-testing method.

SOME TARANAKI PASTURES IMPROVED BY TOP-DRESSING WITH POTASH.

RESULTS OF PASTURE TOP-DRESSING EXPERIMENTS IN TARANAKI.

W. J. McCulloch, Fields Superintendent, Palmerston North, and J. M. Smith, Instructor in Agriculture, New Plymouth.

Within the last few years the results of a number of observational top-dressing trials fairly widely distributed throughout Taranaki have definitely demonstrated that the supply of phosphate is not the only factor controlling grassland production over a large proportion of that province, but that the addition of potash is also very important.

Conclusion based on Field Trials.

Such a conclusion has been arrived at after very careful observation of trials wherein potash and phosphate singly and in combination have been applied. In practically all trials in North Taranaki the evidence to date clearly indicates that the customary expenditure on phosphatic fertilizer would be less profitable than an equal expenditure on a fertilizer containing both potash and phosphate.

Whether the explanation is that there has always been a deficiency of potash as well as of phosphate in Northern Taranaki soils, or a recently created deficiency of potash mainly brought about as a result of unbalanced manuring—*i.e.*, the use of phosphate only—over a lengthy period, can only be conjecture, but the fact remains that in top-dressing on a large number of farms in Taranaki to-day the use of potash is as important as that of phosphate.

It is generally recognized that the production of dairy-produce makes a fairly heavy demand on soil fertility, and any neglect to replace the drain may sooner or later result in bringing into prominence certain soil deficiencies. In order to obtain information on such points, a series of simple pasture top-dressing trials were laid down throughout Taranaki in common with other districts in New Zealand.

The top-dressing materials used in these trials were superphosphate, 30 per cent. potash and lime separately and in combination.

Taranaki farmers are familiar with the marked phosphate responses which invariably occurred in the early days of top-dressing with slag or superphosphate, and the position to-day is that the inclusion of potash is giving just such outstanding results, although to-day there is the difference that the addition of potash changes a medium to good pasture to an extremely good one, whereas previously the addition of phosphate changed a poor or fair sward to a good one.

The knowledge that on certain pastures potash is one of the limiting factors will explain to many farmers the perplexing position where, despite liberal phosphatic dressings, pastures may be proving difficult to maintain at a steady standard of production or may even tend to decline.

While experimental work to date in Taranaki discloses certain important facts in connection with the use of potash it has been decided to prosecute the work further in an endeavour to obtain accurate detailed measurements of the economic value of applying potash.

Recommendation.

However, in the meantime, the data already to hand indicate that on those farms where ample dressings of phosphate fail to maintain the pasture at a reasonably high standard, serious consideration should be given to the inclusion of potash with phosphates. The writers recommend the use of not less than 1 cwt. of 30 per cent. potash per acre, even although for financial reasons it means reducing the usual amount of phosphate applied. Where two dressings of fertilizer are being made annually, the potash should for preference be combined with the autumn (March to May) dressing on grazing pastures, or as a spring dressing for hay or silage paddocks.

Results confined to Limited Area.

The work already carried out in Taranaki indicates that potash is generally important on the intensively farmed land in that block of country lying to the north of a line between Opunake and Stratford (and extending to Toko) and west of a line between the Stratford district and Urenui. South of this area potash effect is less consistent and generally less pronounced, although it is certainly worth trial in an experimental way as suggested below.

Future investigation will more clearly define the boundaries within which good responses are definite. In the meantime it is recommended that farmers within the boundaries mentioned should at least try the effect of a strip of 30 per cent. potash at not less than 2 cwt. per acre, or muriate of potash at not less than 130 lb. per acre, in addition to phosphate, across certain pastures where phosphate alone has been in use over a period of years. Such a trial would prove convincing to those interested, and would also assist generally in furthering future investigation to be carried out by the Department of Agriculture. The quantity suggested for trial purposes—viz., not less than 2 cwt. of 30 per cent. potash or about 130 lb. of muriate of potash, may seem heavy and costly. This quantity is suggested because it is likely to give a definite result easily visible to the eye if response does occur. It does not follow that this quantity is necessarily the most economic, but for trial purposes the effects of smaller quantities, although they may be quite profitable, will be more difficult to observe.

IRRIGATION IN CANTERBURY.

REPORT BY ROBERT L. JAMES REVIEWED.

F. W. HILGENDORF, Canterbury Agricultural College, Lincoln.

THE report of Mr. James, Lecturer in Engineering at Canterbury Agricultural College, on certain irrigation experiments in Canterbury during 1933, appeared in the *Journal of Science and Technology*, Vol. XV, No. 4. It is a detailed technical paper of great value as a record of the first exact experiments on irrigation ever conducted in Canterbury, and of one particular trial which is the most elaborate that has ever been conducted in New Zealand. The work was undertaken on the initiative of the Lands Department, of the Canterbury Chamber of Commerce, and of the Canterbury Progress League, but most of it was carried through only by Mr. James's devotion and enthusiasm.

The description covers six experiments of different degrees of complexity, distributed between Oxford and Ashburton. All were designed to measure the difference in carrying-capacity between the irrigated and non-irrigated areas. There were usually from four to six plots fenced in, and half of these were irrigated and half left in the natural state, so as to measure the increased carrying-capacity in sheep days.

The soils were tested for physical properties and compared with irrigated soils elsewhere; tables are given for the conversion of requirements of one kind of stock into those of another, so as to place all the trials on a common basis; and correction factors for incomplete watering are explained. Careful records were kept of stock movements, rainfall, depth of water applied and costs of construction on the farm. These costs are estimated at rates for hired labour and implements. No costs of water at the farm boundary are considered, since in all cases the water was supplied free by the controlling authority.

OUTLINE OF EXPERIMENTS.

The following are some details of the experiments:—

HORORATA.

About 6 acres of stony soil were sown in permanent grass, and fenced into six plots of which three were irrigated and three were left dry. No levelling was done: Head ditches and distributing ditches were ploughed out and trimmed by hand. The total cost of this was £1 5s. per acre. The figure is unusually high partly because only a small area was treated, and partly because the small quantity of water available (only one-fifth of a cusec) necessitated the forming of many more ditches than usual. The total water applied varied from 7 in. to 15 in. on different plots. The non-irrigated plots carried an average of 1·1 ewe hoggets in March and April, while the irrigated plots carried an average of 7·1 sheep during the same period. The effect of the watering was to allow the carrying of 6 more sheep per acre during two critical months.

OXFORD.

Twenty acres being ploughed were roughly levelled by harrows, and shallow banks to make border dykes were thrown up by means of a home-made ridger. The total cost of gates, weirs, ditches, banks, and

levelling came to 12s. 6d. per acre. Six plots were formed, of unequal areas, but three were watered and three unwatered. Perennial Canterbury rye-grass was cross drilled on 31st December, Five inches of water were given in two applications, and the plots were grazed chiefly by store lambs in April and May. All were sent away fat. The non-watered plots fattened 1·3 lambs per acre, and the watered plots fattened 9 lambs per acre.

MOTUKARARA.

This is a dairy farm of 102 acres on land occasionally flooded by Lake Ellesmere. In its natural state the country is rushes and salt weed. Water supplied by artesian wells from 90 ft. to 180 ft. deep is used firstly to leach out lake salt deposits, but chiefly to maintain a sward of grass during the dry season of the year. It takes one man three hours per week to look after the irrigation ditches. Five fields totalling 76 acres were under observation. They carried on the average a cow to 2 acres during four months of the autumn. Adjoining fields carried no stock during the same period.

SOUTHBRIDGE.

On light stony land at Oakleigh about 4 acres were fenced into four plots, two of which were irrigated and two not irrigated. The pasture was old rye-grass and subterranean clover, very open. The cost of distributing-ditches, &c., was £1 2s. per acre, which is much higher than it would be if a larger area were served. About one cusec of water was available, and water was applied thrice to a total depth of 7 in. Southdown rams were used in the trial. The watered plots during the month of April, which was very dry, carried nearly 4 of these sheep per acre, while the unwatered plots carried nothing.

SEAFIELD.

This experiment was laid out on light wheat land near Ashburton. The property belongs to the Lands Department, which provided the money for the trial, and unemployed labour was largely used. Mr. Flay, of Lincoln College, advised on cultivation and sowing.

The trial is described as one of the most complete experiments in irrigation that have ever been conducted in New Zealand. An area of about 70 acres was irrigated by various means.

A. Border Dykes.—Here the ground was ploughed, graded, and levelled, and banks were moulded up to form watered beds 5 chains long by 60 links wide. Elaborate races and gates were constructed, every facility being provided for applying the water quickly and cheaply, and for securing an accurate measure of the water used. Allowing for standard rates for the hire of horses, tractors, graders, scoops, &c., the purchase of high-grade timber for boxes and gates, the formation of banked races above ground-level, and of concrete measuring-weirs, &c., and using unemployed labour at 6s. 5d. per man per day, the cost worked out at about £9 10s. per acre. This high cost is inseparable from the border-dyke system, and especially in one laid down for experimental investigation, but it is a capital expenditure—maintenance costs will be negligible and the costs of application of water will be very low. After the ground was levelled and banked it was sown with

a mixture of rye-grass, cocksfoot, and red and white clovers, all of permanent strains except the red clover. Twenty-eight acres of the area were then fenced into fourteen sections of 2 acres each, of which seven were watered and seven left dry, so that the carrying-capacity of the land watered and unwatered could be measured.

The grass was sown on 1st January, 1933; watering started on 24th February, and a total of 7·5 in. of water was applied. Lambs were turned on to the grass on 21st April. From then until 13th June, lambs were carried and fattened at the rate of 5·4 lambs per acre on grass alone, on the watered sections. The grass on the unwatered sections grew so poorly that it could not be grazed at all, and carried no stock.

B. Border Ditches.—An adjacent 40 acres of matted browntop was watered by the much cheaper method of ploughing ditches along the highest parts of the field, blocking them at intervals, and allowing the water to flow over the grass. The cost of this worked out at 13s. 6d. per acre for head races and distributing-ditches.

It must be remembered that this was the poorest type of grass, of very low carrying-capacity in the best of circumstances. From January to June, 1933, the unwatered parts of the block carried an average of 0·75 dry sheep to the acre. The 40 acres of watered land carried an average of 3·5 sheep to the acre.

Summary.

Six irrigation experiments in Canterbury during 1933 were described. Costs of water at the farm boundary are not considered.

Costs of construction of races, boxes, gates, &c., on the farm are given. The costs are higher than normal owing to the small area, sometimes only 4 acres, served by the races. These costs are incurred once for all. They are not annual expenditures. The amount of water applied was measured in all cases. It averaged about 7 in.

Watered and unwatered sections adjacent to each other were used to measure the effect of irrigation.

The effect of irrigation on grass-growth was measured by the extra number of sheep (in one case cattle) carried per acre during the period of the experiment.

Results.

1. Hororata.—Initial cost £1 5s. per acre: Carried 6 extra dry sheep per acre during March and April.

2. Oxford.—Initial cost 12s. 6d. per acre: 7·7 extra lambs fattened per acre in April and May.

3. Motukarara.—Initial cost not known: Shallow artesian wells. One extra cow carried per two acres during four autumn months.

4. Southbridge: Initial cost £1 2s. per acre: Carried 4 extra rams per acre during April.

5. Seafield (Border Dyke).—Initial cost £9 10s. per acre (experimental): Fattened 5·5 extra lambs per acre in May and June.

6. Seafield (Border Ditch).—Initial cost 13s. 6d. per acre: Carried 2·6 extra dry sheep per acre from January to June inclusive.

Several of the experiments were carried out on poor grass where the best results could not be expected.

The reviewer wishes to express his admiration of Mr. James for having secured such results in the face of great difficulties, and with the most meagre financial resources. He has shown that from the agricultural viewpoint, irrigation in Canterbury can be highly advantageous. When the cost of water at the farm boundary is known, the work of Mr. James will allow an exact estimate of the profitableness of irrigation in Canterbury.

EXPERIMENTS ON CONTROL OF SOME CEREAL DISEASES BY SEED-DUSTING.

J. C. NEILL, Field Mycologist, Mycological Laboratory, Plant Research Station, Palmerston North.

I. THE CONTROL OF OAT-SMUT.

THE experiments herein recorded were designed to afford information on the relative value of certain seed-dusting materials for the control of oat-smut. Samples of commercial lines of oats were shaken in a closed container with each dust at the rate of 4 oz. per bushel, any excess dust being subsequently removed by screening. Ten to fourteen days after dusting the seed was sown by hand in four rows one rod long, 100 seeds per row, a similar quantity of seed from the same sample being sown without any treatment. At maturity the resultant plants were pulled, examined, and recorded. Both *Ustilago avenae* and *U. levis* were present in most samples, but, since rapid field differentiation between the two species is difficult and at times uncertain, and since no difference was apparent in their reaction to the treatments, both were recorded under the general title of oat-smut. No significant differences in plant vigour could be detected at any stage between any of the treatments and the untreated controls.

Table 1 records the results using three organic mercury and three copper dusts on two lines of oats. Table 2 records the results when using two organic mercury dusts on thirty-six different lines.

Table 1:

Variety.	Plants harvested per 100 Seeds sown.													
	Control.		Agrosan G.		Ceresan New.		Ceresan.		Copper Carbonate (20% Cu.).		Copper Carbonate (51% Cu.).		Copper Oxychloride (53% Cu.).	
	Total.	Smutted.	Total.	Smutted.	Total.	Smutted.	Total.	Smutted.	Total.	Smutted.	Total.	Smutted.	Total.	Smutted.
		%		%		%		%		%		%		%
Dun, Sample 38 ..	84	23·7	89	2·0	84	0·0	85	0·0	87	4·0	89	4·7	88	2·8
Algerian, Sample 37 ..	84	3·0	92	1·1	88	0·0	81	0·0	86	2·0	90	3·0	84	0·6

SUMMARY OF RESULTS.

The results indicate that copper carbonate and copper oxychloride dusts are not efficient preventives of oat-smut. Of the organic mercury dusts Ceresan and Ceresan New gave almost perfect control

Table 2.

Variety.	Plants harvested per 100 Seeds sown.					
	Control.		Agrosan G.		Ceresan New.	
	Total.	Smutted.	Total.	Smutted.	Total.	Smutted.
		Per Cent.		Per Cent.		Per Cent.
Algerian—						
Sample 1	87	0·0	82	0·6	86	0·0
Sample 2	86	0·6	87	0·0	90	0·0
Sample 16	71	1·4	68	0·6	73	0·0
Sample 17	71	0·0	68	0·0	66	0·0
Sample 18	79	0·6	88	0·0	87	0·0
Sample 19	78	0·0	75	0·0	81	0·0
Sample 20	72	0·7	81	0·0	77	0·0
Sample 21	74	0·6	78	0·0	78	0·0
Sample 22	71	10·5	86	0·5	78	0·0
Sample 23	83	20·5	82	0·0	75	0·0
Sample 25	60	1·6	61	0·0	65	0·0
Sample 26	62	0·0	62	0·0	65	0·0
Sample 28	61	0·0	72	0·0	58	0·0
Sample 30	71	10·4	74	0·6	78	0·0
Sample 31	85	2·1	80	0·6	83	0·0
Sample 36	75	0·0	88	0·0	78	0·0
Sample 35	77	0·0	68	0·0	70	0·0
Sample 33	75	0·0	79	0·0	75	0·0
Garton—						
Sample 3	79	2·6	75	0·0	70	0·0
Sample 4	62	1·6	64	0·0	68	0·0
Sample 5	68	3·0	71	1·4	67	0·0
Sample 6	76	0·6	70	0·0	87	0·0
Sample 7	69	6·5	79	0·0	73	0·0
Sample 24	58	0·9	63	0·0	64	0·0
Sample 27	74	43·0	79	1·8	71	0·0
Garton (clipped)—						
Sample 29	81	10·5	83	1·2	83	0·0
Garton—						
Sample 34	84	0·0	76	0·0	87	0·0
Dun—						
Sample 8	74	3·3	85	0·0	72	0·0
Sample 9	73	25·2	75	0·5	80	0·0
Sample 10	79	16·0	82	0·0	79	0·0
Sample 11	86	10·6	86	1·1	79	0·0
Sample 32	79	25·3	94	1·1	78	0·0
Black Tartar—						
Sample 12	66	37·6	80	2·0	57	0·9
Sample 13	64	39·7	66	0·0	59	0·0
Sample 15	74	12·1	80	3·1	81	0·6
Black Supreme—						
Sample 14	61	15·4	56	1·8	58	0·0
Mean, 36 lines ..	73·2	8·4	79·1	0·45	74·3	0·04

of smut with a slight increase in the number of established plants as compared with the controls. Agrosan G. gave a lesser measure of smut-control, but a still higher establishment of plants.

II. THE CONTROL OF BARLEY DISEASES.

The object of the present experiments was to determine whether some one of the modern dust treatments might not with advantage be substituted for the formalin and bluestone steeps at present in general use for "pickling" barley seed. Samples of eight lines of

barley seed were used, each treatment being sown in four rows one rod long at 100 seeds to the row. The dusting was carried out by shaking the seed in a closed container with a surplus of the dust, being then screened to remove any not closely adhering to the seed. This method was chosen as representing in miniature the action of most continuous-action power dusting machines.

At harvest-time the plants were individually pulled, examined, and recorded. No visible differences in vigour appeared between the treatments at any stage of growth.

Table 3 indicates the results.

Table 3.

Treatment.	Plants per 100 Seeds sown.	Disease.			Sample.
		Per Cent. Smut.		Per Cent. Stripe.	
		Loose.	Covered.		
Control (untreated) ..	73	6·7	0·3	5·7	Cape No. 8.
Hot-water (5 hrs. at 60° plus 5 min. at 127° F.)	71	0·0	0·0	0·0	Cape No. 8.
Ceresan New	76	2·0	0·0	0·0	Cape No. 8.
Ceresan	77	1·3	0·0	0·0	Cape No. 8.
Agrosan G.	83	3·6	0·0	0·3	Cape No. 8.
Copper carbonate (No. 1, 20% Cu.)	85	1·8	0·0	1·6	Cape No. 8.
Copper carbonate (No. 2, 51% Cu.)	87	3·2	0·0	1·8	Cape No. 8.
Copper oxychloride (Smutol), (53% Cu.)	80	4·0	0·0	3·4	Cape No. 8.
Control (untreated) ..	90	0·0	2·8	0·0	Chevalier No. 6.
Ceresan New	90	0·0	0·0	0·0	Chevalier No. 6.
Ceresan	81	0·0	0·0	0·0	Chevalier No. 6.
Agrosan G.	82	0·0	0·0	0·0	Chevalier No. 6.
Copper carbonate (No. 1)	87	0·0	1·4	0·0	Chevalier No. 6.
Copper carbonate (No. 2)	88	0·0	0·6	0·0	Chevalier No. 6.
Copper oxychloride (Smutol)	95	0·0	1·3	0·0	Chevalier No. 6.
Control (untreated) ..	85	0·0	0·3	19·6	Cape No. 1.
Agrosan G.	84	0·0	0·0	0·6	Cape No. 1.
Ceresan New	91	0·0	0·0	0·0	Cape No. 1.
Control (untreated) ..	79	2·2	0·3	18·6	Cape No. 2.
Agrosan G.	73	0·7	0·0	0·3	Cape No. 2.
Ceresan New	82	1·5	0·0	0·0	Cape No. 2.
Control (untreated) ..	77	2·6	1·9	15·5	Cape No. 3.
Agrosan G.	83	2·7	0·0	0·0	Cape No. 3.
Ceresan New	82	1·0	0·0	0·3	Cape No. 3.
Control (untreated) ..	91	2·7	0·3	0·0	Cape No. 4.
Agrosan G.	84	2·1	0·0	0·0	Cape No. 4.
Ceresan New	84	2·4	0·0	0·0	Cape No. 4.
Control (untreated) ..	78	0·0	0·3	2·5	Cape No. 5.
Agrosan G.	74	0·0	0·0	0·0	Cape No. 5.
Ceresan New	81	0·0	0·0	0·0	Cape No. 5.
Control (untreated) ..	79	0·0	0·0	1·6	Cape No. 7.
Agrosan G.	78	0·0	0·0	0·0	Cape No. 7.
Ceresan New	83	0·0	0·0	0·0	Cape No. 7.

SUMMARY OF RESULTS.

Loose-smut was eliminated only by hot-water, though reduced somewhat by all the dusts. Covered-smut and stripe disease were reduced by the copper carbonate and copper oxychloride dusts, but the former was completely, and the latter nearly completely, controlled by the organic mercury dusts Ceresan, Ceresan New, and Agrosan G.

STATISTICS OF THE NEW ZEALAND SEED TRADE, 1925–33.

THE accompanying tables concerning the New Zealand seed trade are drafted from official data. Some matters which seem to call for brief comment are—

Table 1, Export 1933.—The breaking-up of the totals for certain seeds into certified and uncertified was not commenced until May, so that, as indicated, the totals shown for the various classes are for eight months only.

Red clover: 750 tons to United Kingdom and 836 tons to Australia—the only buyers.

White clover: Certified—United Kingdom, 14 cwt.; Australia, 31 cwt.; United States of America, 11 cwt. Uncertified—United Kingdom, 74 tons; Australia, 4 tons.

Table 1.—Grass and Clover Seed Export, 1933.

	Eight Months, May–December.		Totals, 1933.	
	Cwt.	£	Cwt.	£
Red clover	..	..	3,168	14,953
White clover—				
Certified	57	726	..	..
Uncertified	1,570	11,261	..	..
Total	..	..	1,801	13,844
Other clover	..	..	1,067	3,044
Brown-top—				
Certified	982	4,122	..	..
Uncertified	521	2,525	..	..
Total	..	..	1,767	8,049
Chewings fescue	..	..	19,337	34,070
Crested dogstail	..	..	3,472	9,114
Cocksfoot—				
Certified	1,026	3,005	..	..
Uncertified	1,338	3,819	..	..
Total	..	..	3,977	13,215
Perennial rye-grass—				
Certified	2,008	2,710	..	..
Uncertified	13,978	16,150	..	..
Other rye-grass—Italian, &c.	18,595	21,889	..	..
Total rye-grass	..	..	44,124	54,660
Other grass	..	..	1,676	2,749
Total, 1933	..	..	80,389	153,698
Total, 1932	..	..	34,359	109,632

Brown-top: United Kingdom, 560 tons; Australia, 160 tons; Canada, 7 tons; United States of America, 4 tons.

Chewings fescue: United States of America, 590 tons; United Kingdom, 293 tons; Canada, 57 tons; Australia, 8 tons.

Crested dogstail: United Kingdom, practically sole buyer, 156 tons.

Cocksfoot: United Kingdom, 111 tons (certified, 34 tons; uncertified, 61 tons); Australia, 84 tons (certified, 14 tons; uncertified, 3 tons). A substantial increase in the export of cocksfoot is shown. and of the total of 200 tons, 130 tons was shipped in the first six months of the year when prices were low. For 1934 it is anticipated that short supply and high prices will result in a small export only.

Rye-grass: United Kingdom, 1,440 tons (certified, 75 tons; uncertified, 629 tons; Italian, &c., 735 tons). Australia, 726 tons (certified, 24 tons; uncertified, 56 tons; Italian, &c., 645 tons). United States of America, 15 tons uncertified, 9 cwt. certified. Of the United Kingdom purchase, 70 tons was made in December, when the price of certified rye-grass was at the lowest level since the inception of the certification scheme. Of the total of 2,200 tons export, November and December shipments accounted for 800 and 700 tons respectively—this in response to a heavy demand from England following a shortage in the Irish crop. Whether the New Zealand seed, mostly of an inferior strain, will provide a satisfactory substitute remains yet to be seen.

Table 2, Imports, 1933, calls for no comment.

Table 3, Exports, 1925–33:—

Clovers: Fluctuations in clover export follow fairly well the amount of seed in supply in overseas markets. For instance, a red-clover failure in Canada in 1927 was followed by a record export of that seed to Canada and Great Britain. Again, in 1930, Canada and Australia shared equally the export, whereas in 1931–32 Canada was not a buyer, the United Kingdom and Australia sharing the total. For white clover the United Kingdom is the chief buyer, Australia being the second.

Table 2.—Seed Imports, 1933.

	Cwt.	£		Cwt.	£
Red clover ..	578	2,146	Timothy	3,201	4,664
White clover ..	279	1,645	Other grass ..	567	1,861
Alsike clover ..	659	1,976	Total grass and clover	7,797	25,476
Other clover ..	866	4,348	Rape and kale ..	5,354	11,262
Cocksfoot	..	..	Turnip and swede	5,120	22,088
Lucerne	224	564			
Paspalum	1,212	7,987	Total, 1933 ..	18,271	58,826
Poa pratensis ..	..	..			
Rye-grass	211	285	Total, 1932 ..	22,153	75,873

Table 3.—Grass and Clover Seed Exports, 1925–33 (in Hundredweights).

	1925.	1926.	1927.	1928.	1929.	1930.	1931.	1932.	1933.
Red clover	4,253	4,657	9,628	1,495	994	2,393	3,224	2,485	3,168
White clover	647	2,115	2,388	835	1,358	2,039	2,930	1,726	1,801
Other clover	985	717	928	360	690	794	264	521	1,067
Brown-top	514	475	301	1,131	3,473	4,697	2,496	2,073	1,767
Chewings fescue ..	7,483	13,923	17,418	17,124	16,847	12,806	14,910	13,455	19,337
Crested dogstail ..	3,985	2,309	5,434	4,844	4,363	4,656	3,180	887	3,472
Cocksfoot	*	*	*	750	1,521	764	2,967	1,862	3,977
Perennial rye-grass ..	23,241	29,546	50,162	20,581	25,947	5,954	9,486	10,274	44,124
Other grass	5,071	4,685	4,489	3,157	3,289	2,815	1,701	1,782	1,676
Totals .. Cwt.	46,159	58,427	90,748	50,277	58,482	36,918	41,158	34,065	80,389
Totals .. £	15,509	203,798	257,136	162,603	185,270	167,979	155,969	110,763	153,698

Brown-top: The export increased from 25 tons in 1925 to a peak of 230 tons in 1930 (United States of America, 130 tons),† when, following the imposition of a duty of 40 cents per pound by the United States of America, the trade—a very promising one—has fallen off considerably. It is of interest to note here that the

* Included in "Other grass."

† Importations into United States of America in 1930 (254 tons) includes late 1929 shipments.

40 cents represented the difference between production costs on the Pacific Coast and in New Zealand. Following 1930 the American purchases fell in 1931 to 73 tons, in 1932 to 50 tons, and in 1933 to 4 tons only. Britain's largest annual purchase prior to 1928 was 1 ton, to be followed by 12 tons in 1929, 50 in 1930, 33 in 1931, 64 in 1932; and 1933, 56 tons.

Chewings fescue has for many years been the Dominion's most consistently large export seed, with America as the chief buyer, although Britain's requirements are steadily increasing.

Cocksfoot: The export shows an increasing tendency, and, given average productive seasons, is a promising export commodity.

Rye-grass: Up to 1929 rye-grass showed the largest annual total in quantity, but for 1930–32 very reduced totals are shown. The record for 1927 was due to an Irish failure, which was followed by heavy purchases by Great Britain and the United States of America. Up to this time the United States of America had been a consistent purchaser of New Zealand rye-grass, but following 1928 (170 tons) the trade has fallen right off to nil in 1932 and 15 tons in 1933, of which 10 tons were Italian. Australia has been the most consistent, although not the largest, purchaser.

Table 4, Imports, 1925–33:—

Clovers: Generally a falling tendency is shown.

Cocksfoot: Since the peak of 780 tons in 1926, the importation has fallen away until in 1933 there is a nil return. The export figures for cocksfoot provide an interesting comparison. Staining under the Seeds Importation Act commenced the process of elimination of Danish seed in this country, while knowledge of strain variations and low prices have completed it. Nevertheless, with the high prices ruling for New Zealand seed, Danish seed will most assuredly be imported during 1934—probably not in any great quantity. The antipathy towards stained seed still exists—not necessarily because it is Danish, but because it is artificially marked—but were it not for this fact seed would be imported in quantity this year.

Table 4.—Seed Imports, 1925–33 (in Hundredweights).

	1925.	1926.	1927.	1928.	1929.	1930.	1931.	1932.	1933.
Red clover	6,451	8,285	2,657	762	1,178	736	167	1,362	578
White clover				1,848	1,368	461	24	336	279
Alsike				2,898	1,517	2,032	81	961	659
Other clover				1,370	765	1,068	609	724	866
Cocksfoot	10,091	15,616	5,619	9,152	4,199	232	74	185	Nil
Lucerne	1,027	575	527	17	50	294	37	687	224
Paspalum	1,378	1,717	1,940	3,026	2,615	1,370	572	1,503	1,212
Poa pratensis	*	*	*	51	249	201	50	110	Nil
Rye-grass	40	334	69	20	795	4,501	348	268	211
Timothy	4,142	1,989	2,905	4,965	2,903	2,552	1,786	2,638	3,201
Other grass	3,004	3,604	1,741	1,813	1,521	511	512	1,016	567
Total grass and clover Cwt.	26,133	32,120	15,458	25,922	17,160	13,958	4,260	9,790	7,797
Total grass and clover £	122,754	143,065	63,793	112,598	79,456	37,866	13,593	31,241	25,476
Rape and kale	3,741	4,124	3,437	3,562	4,587	5,416	4,567	5,501	5,354
Turnip and swede ..	4,153	5,038	4,751	5,045	5,714	4,094	4,059	6,482	5,120
Totals .. Cwt.	34,027	41,282	23,646	34,529	27,461	23,468	12,886	21,773	18,271
Totals .. £	154,979	179,257	106,472	149,008	124,579	95,277	43,844	75,873	58,826

* Included with "Other grass."

Paspalum is one of the larger items on our list of the imported grass and clover seeds, but with proper methods of harvesting in New Zealand it is thought that much of this importation could be replaced by locally grown seed. *Poa*

pratensis, judging by the quantity of seed imported, is not an important constituent of New Zealand grassland. In rye-grass—the annual importation is small—the 225 tons shown for 1930 was imported following over-production in Ireland with extremely low prices. Australian merchants bought heavily from Ireland that year, and in consequence their purchases of New Zealand seed were the lowest for the nine-year period under review. Timothy—of the grasses and clovers—is imported in greatest quantity with a normal fluctuation. Rape, kale, turnip, and swede seed importations show a rising tendency.

Table 5.—Garden Seeds Imports, 1925–32.

		1925.	1926.	1927.	1928.	1929.	1930.	1931.	1932.
		£	£	£	£	£	£	£	£
Flower and vegatable		39,560	39,647	47,137	38,667	48,489	46,486	30,209	26,680
Peas and Beans Exports, 1925–32.									
Peas	Centals	128,937	109,619	162,649	220,954	173,792	125,655	68,780	105,814
	£	102,301	99,167	151,157	185,705	120,522	85,915	56,897	80,498
Beans	Centals	390	938	283	127	250	283	695	470
	£	312	798	558	308	493	602	1,813	1,011

—*N. R. Foy, Seed Testing Station, Palmerston North.*

IMPROVEMENT IN EXTERNAL TRADE.

THE export season is rapidly approaching its zenith; February, March, and April normally being the peak months of the year. Exports (excluding specie) during February, 1934, were valued at £6,249,026 in New Zealand currency, equivalent to £4,999,000 on a sterling basis—the highest monthly total in New Zealand currency since January, 1930; and, on a sterling basis, since March, 1930. The value of exports is still, however, considerably below the totals recorded during the peak years, the value during February of 1928 and 1929, for example, being £7,842,822 and £8,056,083 respectively. Nevertheless the position shows a very marked improvement when compared with 1931, 1932, and 1933. The following comparison of the Dominion's main exports in February, 1933 and 1934, is of interest in this connection:—

Commodity.	February, 1933.		February, 1934.	
	Quantity.	Declared Value.	Quantity.	Declared Value.
	Cwt.	£(N.Z.)	Cwt.	£(N.Z.)
Butter	137,735	593,338	389,502	1,388,806
Cheese	183,236	455,353	180,438	432,989
Lamb	328,532	778,303	278,771	824,328
Mutton	101,992	144,634	99,742	167,024
	Bales.		Bales.	
Wool	140,500	1,210,720	139,987	2,671,362

The striking improvement in the return from wool exported is the outstanding feature of February export statistics. Lamb and mutton also show a considerable improvement as compared with the position twelve months ago; the increased return from exports of butter, however, being purely a reflection of an abnormally heavy quantity exported during February of this year.

The recorded value of imports (excluding specie) during February was £1,592,689, equivalent to £1,945,000 on a New Zealand currency basis, and to £1,556,000 on a sterling basis. The value of imports during the month was slightly below that for the corresponding month of last year.

—*Monthly Abstract of Statistics.*

SEASONAL NOTES.

THE FARM.

Weaknesses in Pasture Utilization.

INADEQUATE supplies of feed to supplement that available directly from grassland in winter and early spring commonly are associated with two distinctly undesirable results.

The most obvious of these results is a greater incidence of stock disease. Disease in many forms is levying a heavy toll on live-stock returns, and observation and investigation point to the conclusion that faulty feeding, especially in the winter and early spring, materially increases the ravages of disease.

Less obvious, though possibly not less serious, is the effect of unduly scant reserves of feed for winter and early spring upon grassland itself. This effect arises from the fact that grazing too often or too closely in the early spring in the manner necessitated when reserves of feed are insufficient has a decided influence in changing the botanical composition of pastures and in reducing the subsequent yield of those valuable species, such as perennial rye-grass, which are characterized by early growth. In general, inadequate provision of feed to supplement the pastures in winter and early spring leads both to overgrazing in the spring and undergrazing in the summer—a pasture-management position widely obtaining in New Zealand. The influence of management of this nature was illustrated in recent research in Britain by Martin G. Jones, who subjected portions of an old pasture to differential treatment. After two seasons one portion which was overgrazed in the spring and undergrazed in the summer, as in previous years, remained fairly constant in composition and contained 1·7 per cent. of perennial rye-grass. In another similar portion of the same pasture, lenient treatment in the spring resulted in the amount of perennial rye-grass increasing to 19·4 per cent. Incidentally, importance attaches to the fact that in the same investigation close grazing of plots throughout the growing-season, and particularly in the spring, resulted in a remarkable increase in the content of white clover—from 5·8 per cent. to 48·6 per cent. in one instance, and from 3 per cent. to 53·5 per cent. in another instance. Further, in the same investigation, plots which constantly had been overgrazed in the spring and undergrazed in the summer contained 9·3 per cent. and 10·4 per cent. respectively of useful plants, whereas originally similar plots, after two seasons of controlled grazing, contained 48 per cent. and 64·8 per cent. of useful plants. These striking results exemplify to what an extent at times grazing management can become the directing force relative to the composition of a sward. Significance attaches to the fact that all the changes specified above took place in the short period of two seasons, and that, apart from grazing management, conditions were similar.

The influence of grazing management is exerted partially through differential weakening of the various species owing to variations in intensity of grazing at different times of the year: a species which grows when grazing is severe—*e.g.*, rye-grass—is likely to suffer much more drastic defoliation than one which is characterized by active growth when grazing is relatively lenient—*e.g.*, brown-top and sweet vernal.

Summed up, the method of grazing management—unfortunately very common in New Zealand—which involves overgrazing in the spring and

undergrazing in the summer tends to the suppression of perennial rye-grass and the dominance of species akin to brown-top and sweet vernal.

The solution of the problem of avoiding such an undesirable result lies along the lines—(1) of eliminating, as far as possible, critical defoliation of desirable species, and (2) of providing conditions which assist in recovery from the weakening effect of any critical defoliation which it is not practicable to avoid. By critical defoliation is meant that from which a species suffers most—which is determined not only by the intensity but also by the time of occurrence of the defoliation. Defoliation during the early growth of the season seems to be especially weakening.

Pre-winter top-dressing is a current measure of considerable value in minimizing the results discussed above. In the first place, it has been noted that the availability of plant-food plays an important part in the recovery of various species after being defoliated. Further pre-winter top-dressing may well reduce the severity of the defoliation at the critical season. This is because in many districts in which grassland is dominant appropriate top-dressing carried out in the April–May period may be expected to assist in the provision of feed for stock through the difficult July–September period. Quickly-acting phosphates applied in April or early May generally bring about an almost immediate increase in the growth of pastures. Often an increase in growth at this stage would result in stock entering upon the severe part of the year with greater strength and better bodily reserves, and, in addition, through much of the winter and early spring such autumn top-dressing will cause increased growth of grass.

Hence any farmers who may have to face a probable July–September shortage of feed should strive to their utmost to improve the critical feed-supply by top-dressing in April or May.

That the number of farmers to whom this applies is extensive may be realized from the fact that a fundamental weakness in our life-stock industry is inadequate provision of feed for late winter and early spring. Especially is it applicable to farmers who are wintering more stock than they have wintered recently.

Pre-winter top-dressing tends to minimize not only overgrazing in winter and early spring, but also undergrazing in summer : at the advent of summer the influence of pre-winter top-dressing is partially exhausted, and so it is less likely to cause in late spring and early summer the great rush of feed which at times follows early spring top-dressing and which readily leads to undesirable undergrazing.

The fundamental justification for pre-winter top-dressing in preference to spring top-dressing with phosphates is summed up in the fact that it tends to even the rate of grass-growth throughout the year, and, as a rule, manures are used to best advantage on New Zealand grassland when they do this to the greatest possible extent. It is quite unsound to deduce from this that top-dressing alone can be employed satisfactorily to adjust the feed-supplies from season to season to meet the feed-requirements from season to season. The true position is merely that pre-winter top-dressing with phosphates disturbs less than does similar spring top-dressing the balance between seasonal feed-production of grassland and seasonal feed-requirements of stock. Actually it would seem from investigational work, which has been carried out at Marton and which is confirmed by field experience, that phosphatic top-dressing, whether carried out in the autumn or in the spring, increases instead of lessens the absolute difference between the growth in the period of low production and that in the period of high production of grassland. For instance, in 1930 at Marton the difference between the daily production in May–August and that in mid-November on land which had not been top-dressed was 107·1 lb., whereas the corresponding difference on land which had been top-dressed with phosphates

ranged from 128·9 lb. to 145·2 lb., according to the class of phosphate used and the date of its application. Incidentally, it is of practical importance that the smaller differences, due to top-dressing, between the period of high and of low production were associated with the less effective phosphatic top-dressing. In this instance phosphatic top-dressing invariably increased the gap between winter and summer production. This fact emphasizes the need for giving attention to the future provision of special feed to which reference is made later.

Treatment of Young Pastures.

Special care in the treatment of young pastures is advisable. The plants having been given proper opportunity to establish themselves, should neither be allowed to become long and productive of flower-heads nor be eaten down closely and continuously. To keep the growth suitably controlled, it is usually best to turn in a relatively large number of stock for a short time only. This method of grazing avoids the selective hard grazing of the most attractive species and the neglect of other species which is apt to occur in case of light stocking. Properly controlled stocking, which prevents undesirably rank growth during the youth of the pasture, leads to the stooling-out of the plants, and this gives a denser sward. Stock should not be grazed on young pasture if the ground is softened by rain, for trampling of wet, soft ground will lead to the killing-out of plants and poaching of the soil in such a manner as to lead to invasion by weeds. The damage from undergrazing of young pastures may readily become particularly serious when Italian rye-grass and red clover (at times called cow-grass) are prominent in the pasture—these temporary species outgrow, and, in consequence, if not controlled, weaken the slower valuable permanent species by shading.

Harrowing of Pastures.

Especially in difficult times, when the use of artificial fertilizer is being restricted, proper use of animal manure available on grassland in the form of droppings is particularly desirable. Proper use calls merely for the inexpensive work of harrowing sufficiently to bring about thorough distribution, without which animal manure tends to harm instead of to benefit the pasture.

Pastures consisting of a matted growth usually call for relatively drastic harrowing amounting to cultivation, which aerates the surface layer and facilitates the subsequent development of youthful leafy growth. The considerable fertilizing-value of animal droppings may be gauged to some extent by the rankness of the growth in the vicinity of undisturbed droppings—rankness normally greater than would be caused by applying artificial fertilizer at the rate of many hundredweights an acre.

Future Provision of Special Feed.

At this season it is advisable to draw up a tentative programme of the work of the coming year in respect to the provision of special feed. Though such a programme is likely to be modified later, it is useful at this stage as the basis of decisions about such matters as the location of silage pits or trenches, fencing, and cultivation work, which should now be planned in order that labour may be devoted to it in good time during the next few months.

In general, the fundamental consideration relative to a programme of special feed provision is that the provision has, as a rule, been distinctly inadequate in the past.

In some instances there has been a tendency to place too much dependence upon the reserves of feed that can be built up by means of grass ensilage. Because of uncertainty about the weather of next season there is no certainty whatever that next summer will yield enough surplus grass-growth to give reasonably safe supplies of silage. Further, ensilage as

commonly practised fails in respect to the quality as distinct from the quantity of the supplementary feed often required at critical seasons. Fortunately, accumulated experience in these matters is leading to a wider recognition of the fact that, after making due allowance for the valuable role of ensilage, it is, as a rule, advantageous to grow special crops such as mangels, turnips, &c., for the purpose of assuring both adequate and suitable supplies of special feed to supplement that available from grass-land during periods of low production.

Of seasonal importance in respect to such crops is the fact that the mangel—which with advantage could be grown much more extensively—when sown after grass, often gives the largest and most profitable crops as the result of ploughing about May. Such ploughing allows for the thorough decay of the buried sod and results in a more fertile soil due partly to the rotted sod becoming well incorporated with it. If it is not practicable to plough at this stage, then it will be advisable in the spring to carry out either skim ploughing followed by deep ploughing or a disking of the sod before ploughing. The objective of these various measures is to secure a well disintegrated sod which not only means a greater supply of plant-food, but also removes the danger of the rise of moisture from the subsoil being checked.

Autumn preparatory cultivation is also frequently worth while for such crops as potatoes, carrots, and lucerne, especially when these crops follow old pasture. Usually the first step in such cultivation should be skim ploughing, followed, possibly, by disking to break up the sod thoroughly and leave the ground in a suitable condition for the normal deep spring ploughing.

At this stage, in districts in which arable cropping is prominent, no opportunity should be missed of cultivating land for spring sowing, and the fact that lea land can at times be worked safely when adjoining similar land, which has been under the plough recently, is too wet is of assistance in keeping the implements idle as little as possible.

The Cereal Crops.

The notes relative to cereal crops published last month cover generally matters calling for attention in April and May. Some results of recent research work relative to the treatment of seeds of cereals are described elsewhere in this issue. Because of incorrect methods, seed treatment at times is ineffective in the control of disease, and at times causes serious injury of the seeds. Further information about correct methods of seed treatment may be obtained from district officers of the Fields Division.

Autumn Utilization of Crops.

It seems at times to be overlooked that immature animals are less well able than mature animals to undergo hardships. For farm stock winter is often a time of hardship, and, because of their immaturity, calves and hoggets are likely to suffer severely unless they receive good attention. This fact should be taken into consideration not only during winter itself, but also during the period leading up to winter. Calves should be trained to eat such feed as hay and silage while they are still in good condition and before they have to live almost wholly on such feeds. Calves to which there takes place a timely gradual introduction to unfamiliar feeds will be spared the setback which sudden changes of the feed of animals, especially those in poor condition, are likely to bring about.

Similarly, hoggets should be given the best possible treatment; before they have become low in condition they may well be given access to fodder crops from which they should, as a rule, be given a run-off on a suitable pasture—one which is short, clean, and fresh—and changes in their feed should be arranged gradually.

The trampling and firming of lucerne fields which result from grazing during autumn and winter should, as a rule, be avoided, especially if the stand of lucerne is a good one. The firming of the soil favours the ingress of grass and clover which in regions of medium to good rainfall are likely to be serious weeds of lucerne. Should a lucerne area already be badly infested by such plants, then it may be sound practice to utilize the area chiefly as a grazing-field from which it may be possible to obtain up to three cuts a year. —*R. P. Connell, Fields Division, Palmerston North.*

THE ORCHARD.

Late Harvesting.

In a few more weeks the harvesting of fruit generally will be finished for the 1934 season. Very little difficulty should be experienced in packing late varieties owing to the fact that the colour does not have to be considered to such an extent as in the case of some of the mid-season varieties. However, there must be no relaxation in the careful handling of the fruit throughout the picking, grading, and packing of the later varieties. At the present time there is much promise of a heavy crop of Sturmer apples. It should be remembered that this variety of apple is very easily bruised, and extra care should be taken when handling it. Pickers should be warned specially to refrain from the thumb and finger practice when taking hold of the fruit to remove it from the trees. Finger marks (particularly thumb) become visible in a few hours after picking as slight almost circular bruised areas on the fruit, such bruises dry out after a while, but the appearance of the flesh of the fruit is irreparably marred by the presence of a brown patch under the skin. The grading-machine is often blamed for this injury, when in reality the fault lies with the pickers. Overfilling the picking-bags and carelessly emptying them will cause a similar injury to that of finger bruises.

After-harvest Cleanliness.

As soon as possible after harvesting and packing operations for the season are over, the packing-shed should be thoroughly cleaned, and, if necessary, the grader repaired before storing during the off season. All boxes broken beyond repair and rubbish generally should be destroyed by burning, while all waste fruit should be deeply buried. All remaining orchard boxes and props used for supporting heavily laden branches should be collected without delay. Those boxes which are sound should be dipped or sprayed in a strong lime-sulphur solution and stored in a dry position until again required, while those that need attention should first be repaired and then treated as just described.

Trees affected with silver leaf should be marked, otherwise they are easily overlooked once the foliage has disappeared. In districts where fire-blight was known to exist during the past or previous summer a minute inspection should be made for cankers; when located, each canker should be marked with a strip of white cloth, so as it can be removed by cutting well below the canker. The material removed should be destroyed by burning. Every canker removed is a source of infection eliminated.

Spraying of Stone-fruits.

For the better control of brown-rot, leaf curl, die-back, &c., stone-fruit trees should be examined carefully and all cankered and infested shoots, laterals, branches, and mummified fruits removed and destroyed by burning, for it is in such tree-parts that the fungous diseases overwinter by means of hibernating mycelium, as well as by conidia lodged in bud scales. It

is also recommended that trees which have made dense growth should be opened to the sunlight by removing all surplus growth; this will enable the wood and buds for next year's crop to mature. When the above work has been completed the trees should receive an autumn dressing of bordeaux mixture, 5–4–50.

Drainage.

Adequate drainage is essential to the healthy growth of fruit-trees. It not only assists in sweetening the soil but raises its temperature. In addition it increases the depth of soil in which the roots of trees and other plants may feed. The effects of an inadequately drained soil are reflected in the general unhealthy appearance of the trees, normal growth of which is impossible. Trees in a weakened condition readily become subject to fungous and physiological troubles. Hence the importance of adequate drainage, whether pipe or otherwise, cannot be overstressed. The cleaning and deepening where necessary of the outlet drain should be the first consideration. All lateral drains should then be tested, and, if found to be blocked or partially blocked, thoroughly cleaned so as to allow for the free flow of the drainage water.

In some orchards it may be deemed necessary to lay new drains to tap wet parts. If so, care must be exercised when digging the drain to make sure there is a sufficient fall the full length of the drain towards the outlet. When laying a drain in a retentive subsoil ready access for the surface water from the surface to the drain is imperative, therefore if pipes are used they should be covered with clean rubble or scrub. A retentive subsoil placed in direct contact with the pipes will seal them during the wet season and thus prevent surface water reaching the drain. In dealing with underground water, such as springs or seepage, the pipes may be laid in the actual water, but at a sufficient depth to prevent the water rising to within at least 3 ft. from the surface.

New Plantations and Shelter.

Whether autumn or spring planting is contemplated the site should be thoroughly drained and the land cultivated during the previous summer and autumn. Fruit-trees must have adequate shelter, and, if possible, shelter-belts should be planted at least one year before the trees are set out.

In those districts where the soil is light and drainage good planting may be carried out during the month of May, provided, of course, the soil is not in a very dry condition or over wet. Spring planting is recommended, as it allows several months longer for preparation of the land, including drainage, and the establishment of shelter-belts, &c. The order for trees should be placed with a reliable nurseryman as early as possible. It is wise to decide beforehand the purpose or class of trade for which the fruit will be grown and order accordingly. The distance apart for planting should be governed by the nature of the soil and the variety of the tree. On the better class of land stone-fruit should be planted about 20 ft. apart, cherries 25 ft. apart, and apples from 18 ft. to 20 ft., or even 22 ft. apart in the case of varieties which are tall and/or of a spreading habit. On arrival from the nursery the young trees should be unpacked and dipped in a solution of red-oil 1–10 as a safeguard against insect pests and their eggs. They should then be heeled in without delay. For this purpose it is advisable to dig a trench in a moist but well-drained soil and place the trees singly in it in a slanting position. The roots must then be adequately covered up with well-pulverized soil so as to prevent drying out. The trees will stand in such a position without detriment until required for planting.

—J. W. Whelan, Orchard Instructor, Palmerston North.

Citrus Culture.

There are several important factors which make for success in the planting of trees.

Adequate shelter should be well established some time beforehand, so that the growth of the young trees will not be in any way retarded. Without the necessary protection, care, and attention during the first two or three years they will not grow into satisfactory trees.

When selecting a site for planting, utilize land that is well drained and facing the sun. Land that is at all inclined to become water-logged is detrimental to the growth of citrus trees. If the land is not naturally drained steps should be taken to drain it before planting.

The soil should be cultivated thoroughly some time before it is intended to plant the trees. The more time and labour spent in this way the better the results obtained. If the land is at all heavy a good dressing of lime applied immediately after ploughing will assist materially in the subsequent cultivation.

In the selection of trees, poor and stunted ones should be discarded, as only the best may be expected to give good results. Most nurserymen are now working from buds selected from outstanding trees, and as limited stocks only are being worked it is very necessary that trees for intended plantings should be ordered early, so that suitable trees may be obtained.

Planting may be undertaken either in the autumn or spring, but preferably in the spring, as spring planting leaves more time for the land to sweeten and for any further cultivation that may be necessary.

In established groves only shallow ploughing should be carried out, owing to the surface-rooting habit of citrus trees. Excessive cutting of the roots is detrimental to the growing tree.

—L. Paynter, Orchard Instructor, Auckland.

POULTRY-KEEPING.

The Care of the Moulting Hens and the Growing Pullets.

By this time all birds intended for the breeding-pen should have been selected and the moult started if the best results are to be obtained. It is a mistake to leave the selection of the breeding-hens too late, as those external signs which indicate type, production, and, in many cases, constitution, disappear to some extent once a bird ceases laying and begins to moult, and it is only the very experienced poultryman who can successfully select breeding-stock when birds are moulting. In some cases it will be found that a few of the best birds, especially those good two-and-a-half-year-old hens, will continue to lay after this time, and these should be separated from the rest of the flock and put on a light ration of grain for two or three weeks until they cease laying and start to moult.

The object should be to treat the breeders in such a way that they will be in the best condition to produce, early in the season, eggs containing the maximum fertility and vitality, and such results can be expected only when the breeders are allowed sufficient time to build up their energy after a heavy laying-season. It is, therefore, a great mistake to try to get the last egg from the birds in the autumn and expect them to be in a condition to give of their best in the early spring as breeders.

It is well, after the breeders have been selected, to examine them for insects, and if any are found all birds should be treated. If a large number have to be treated, the best method is the application of a small quantity of

nicotine sulphate along the perches just before the birds go to roost. If only a small number have to be treated, the dusting of fine powder into the feathers will rid them of body-lice. A good dusting-mixture can be made up of equal parts of lime, fine dry earth, and sulphur. In addition to treating the birds for external parasites, it is a good idea to give them suitable treatment internally. This may be done by first starving the birds for twenty-four hours, then feeding them a mash made up of equal parts of bran and pollard in which has been mixed a teaspoonful of Epsom salts to each three birds, and one teaspoonful of spirits of turpentine to every five birds. The spirits of turpentine should first be mixed with the bran. The amount of Epsom salts required should be dissolved in hot water and when thoroughly dissolved and the water cold it may be used to moisten the bran and pollard. It is well to mention that better results will be obtained when this mixture is fed cold.

The birds should be well fed during the moulting period, but care must be taken to see that they do not put on too much condition. It is well, therefore, to handle some of the birds from time to time, and if they show signs of getting overfat the amount of grain being fed should be slightly reduced and the mash ration increased slightly. It is advisable to make the birds work for their grain by feeding it in deep litter. This will induce exercise, which is an essential for conditioning stock for breeding purposes. Too much forcing food, such as meat, meat-meal, or milk, should not be given. Good results have been obtained by feeding three times a week a mash consisting of two parts of pollard and one part of bran (by measure) with 5 per cent. meat-meal added. If skim-milk is used for mixing it will not be necessary to add meat-meal. As much of this mash may be given as the birds will consume in about twenty minutes. The grain ration, which is given night and morning (except, of course, when the mash is fed), should consist of equal parts (by measure) of wheat, oats, and broken maize. Maize is, no doubt, rather expensive in the South, but the extra cost is worth while when it comes to the production of good hatchable eggs.

A regular supply of good succulent green-stuff is a very important item for all poultry, but especially so for breeding-stock. In fact, good results could not be expected if the birds were kept short of this their natural tonic.

Though good results have been obtained for the past several years from breeding White Leghorns that are kept on the intensive system, poultry-keepers are advised strongly to give the breeding-birds a range on fresh, clean ground if at all possible.

All pullets should by now be settled in their winter quarters. On many occasions inquiries are made about the cause of early hatched birds going into a moult about this time. Experience has shown that pullets hatched before the middle of August will, if well reared, start laying in January or February and after laying for a few weeks the majority will go into a moult. This will happen under the best of management, and it seems almost impossible to prevent. However, if all the pullets cease laying about the same time, or if a number of the later-hatched birds go into a moult, it is generally a case of mismanagement somewhere. Any sudden change, either of quarters or feed, at this season of the year is likely to cause trouble with laying-pullets. A sudden change of feed such as from old to new season's grain will often cause laying-pullets to cease production and go into a moult. If a poultry-keeper finds he is running out of old season's grain and has to start on new grain it is well to begin by mixing one-quarter of the new with three-quarters of the old, then half and half, and so on, until by the end of ten days' time all new grain is being fed.

After some years of visiting many poultry-plants it has been concluded that overcrowding and underfeeding are amongst the chief causes of many pullets going into a false moult.

Many people are to-day keeping White Leghorns under the intensive system, and, under many local conditions, I am in favour of keeping Leghorn pullets closed up during the autumn and winter months, but they must be given plenty of room to live in. The best results noted under the intensive system were obtained where each bird was allowed 5 square feet of floor space. It would pay the poultry-keeper much better to cull his pullets heavily than to try and keep more birds than he has sufficient room for. No doubt the future egg-production of one's birds is influenced to a great extent by the way in which the young stock is reared.

It is a great mistake to force pullets to early maturity by feeding too much forcing-food such as meat, meat-meal, or milk; at the same time it is a mistake not to give some animal food to growing stock, or to cut off the supply suddenly. More than one case of cannibalism has come under the writer's notice recently where the cause of this trouble was traced to the poultry-keeper having suddenly removed all animal food from the ration as he thought his pullets were coming on to lay too soon, for shortly after the meat-meal had been replaced in the ration the cannibalism ceased.

If at all practicable, it is a good plan constantly to grade the young stock and place those of similar age and size together. As the pullets begin to lay, the quantity and quality of their ration should be gradually increased. It is well to keep a close watch on the laying-pullets and try to keep their weight up, and if it is found that they are losing weight their grain ration should be slightly increased.

On some plants there is not sufficient trough space supplied, with the result that only the strongest pullets, and those with plenty of confidence, get sufficient feed, while the shy and nervous birds have to go short. It is a good plan to allow at least 3 in. trough space for each bird. A regular supply of green feed for the pullets is very necessary, but it is well to remember that the green-feed supply can be excessive during the cold winter months.

A fixed quantity of feed is not advocated. It is advisable to feed as much as the birds will consume greedily, and as soon as they begin to pick the food over, as if they did not care, or seem to be thinking of something else, then they have had sufficient, and a little less may be given next time.

The following is a useful guide for any one wishing to know if his pullets are producing satisfactorily, as it is the average daily production, expressed as percentages, of 336 pullets at the Papanui laying competition during twelve months: April 22 per cent., May 51 per cent., June 53 per cent., July 55 per cent., August 65 per cent., September 74 per cent., October 75 per cent., November 68 per cent., December 64 per cent., January 56 per cent., February 53 per cent., March 32 per cent.

It should be remembered that when these birds entered the test they were all of practically equal age and were amongst the pick of each man's flock.

—*C. J. Cussen, Poultry Instructor, Christchurch.*

THE APIARY.

Management of Supers.

As advised previously the removal of the supers should go on steadily while the bees form their winter clusters. In the case of very strong colonies it will often be found difficult, if not impossible, to confine the bees to one story without seriously diminishing winter stores and unduly crowding the bees. In these cases it is best to leave the supers on till the spring.

The best place for winter stores is in the hive, and, however careful the beekeeper may be in replenishing these, if the honey is removed from the hives

he still runs the risk of allowing the bees to starve if the honey is not within their reach at all times during the cold weather. There are very few districts in New Zealand where brood-rearing absolutely ceases during the winter, especially when the hives are well sheltered, as the bees require food at all times and seasons. On no account should they be allowed to winter in more than two stories. In many cases they will be showing a tendency just now to go as high as they can get in the hives, and where this happens it will usually be found that the combs in the bottom story are deserted and dry. A rapid examination will soon show the beekeeper whether this state of affairs obtains, and, if so, he should remove the bottom story, leaving the cluster undisturbed.

Where queen-excluders have been left on the hives they should be removed, because it sometimes happens that the bees will go through the excluders to the stores above, leaving the queen to perish below. There is always a tendency for the cluster to move to the warmer part of the hive, and an excluder will not act as a bar if the bees are dissatisfied with the lower story.

Mats for Wintering.

To ensure that the bees are kept warm through the cold weather it is absolutely necessary that the frames should be well covered with good mats. Three or four are by no means too many to provide for each hive. Ordinary corn-sacks cut into pieces the size of a zinc queen-excluder answer the purpose admirably, and are very durable. Avoid using calico mats, as these are next to useless for wintering purposes. It is essential that the mats should fit exactly over the frames; if too small they admit draughts, and if too large the edges will protrude beyond the hive-covers, and in wet weather these will absorb sufficient water to cause the mats to become damp and unhealthy and the combs mouldy.

Clearing Weeds.

Weeds should be kept down in the apiary. A good clearing round the hives in autumn will suffice until spring, and will add materially to the comfort of the bees and the well-being of the hives during the winter months. Not only should the entrances be cleared, but the ground all round the hives should be similarly treated, and the weeds raked up and destroyed.

Uniting Colonies.

The presence of weak hives in the apiary must be avoided as far as possible. During the warm autumn days these colonies rarely escape the attention of robber-bees, and are easily molested. When once they are attacked the beekeeper will find it extremely difficult to save them, and eventually they will get robbed despite his efforts. It is by far the better plan to unite them with a stronger colony than to run the risk of unsettling the bees in the dormant season through the encouragement of wholesale robbing.

—E. A. Earp, Senior Apiary Instructor, Wellington.

HORTICULTURE.

The Planting Season.

A CERTAIN amount of planting is done at all seasons of the year, but the removal and replanting of trees and shrubs is practically confined to a period extending from about May to September inclusive, and is known as the planting-season. The object of planting is usually to provide timber for various purposes: shelter for crops, stock, and the homestead; shade for stock and other purposes; crops of fruit and nuts for sale or home use.

These are but a few of the practical results achieved when advantage is taken of the planting-season. The value of the achievements naturally depends on how the work is done, and, speaking generally, we have not made the improvement on the work of the early settlers that might have been expected. The result is best where a good deal of thought has been given to the selection of the trees and to their position and arrangement on the ground. Each locality has its own particular soil and climate. The greatest care is needed to select trees and shrubs that are quite suited to it, as well as the purpose in view. The arrangement and extent of the planting demand the same consideration. These important decisions are best arrived at after studying the results of previous planting in the locality and getting the advice of a local authority.

For fruiting trees, and hybrids that are expected to crop heavily, the very best preparation of the land is required—that is, deep cultivation, the elimination of all bad weeds, and such generous treatment with organic manures as may be necessary. In other cases satisfactory preparation will consist of ploughing and cultivation to clean the land and retain moisture to assist in the establishment of the crop. In such instances it is best to continue the cultivation periodically until the plants are thoroughly established. On steep or rocky country such preparation is not possible, and one has to limit the selection to plants which will succeed when given less attention, merely skimming a few square feet of land, breaking up with a spade the soil that is exposed, and setting the plant firmly in the centre. As grazing cannot be permitted after planting on such areas, owing to damage that may be done to the trees, the grass should be mown and allowed to lie as a mulch to enrich the land and retain moisture. This is usually necessary but once a year, during the month of December.

Planting Small and Sundry Fruits.

In the warmer districts strawberry-planting is still being done, but should be concluded as soon as possible. This subject was dealt with in some detail in the January number.

Bush fruits are planted among tree fruits to only a very limited extent in this country, and it can rarely be recommended. It may be done with advantage sometimes when establishing the home orchard, and so make a return while the trees are getting established. When deciding on the kinds for planting it is necessary to consider the demand for the crop, both for home use and commercial purposes; then comes the consideration of the suitability of the climate, soil and its preparation. Gooseberries, currants, and raspberries thrive best in the cooler districts, an open situation and rather light land suiting gooseberries and red currants, whilst black currants and raspberries require a good loam where moisture is always present as well as good shelter from prevailing winds. To be carefully avoided is the planting of these bushes in the vegetable garden, even on its verge, as their interests clash. The deep cultivation required for vegetable crops is injurious to the fibrous roots of the bushes, and the shade and competition of the bushes is detrimental to the vegetable crops. These berry crops are generally best planted in a block in a section of the home garden specially reserved for perennial crops, such as asparagus, rhubarb, and herbs, as the association has very much in common and there is little chance of their doing one another an injury. Commercial crops are set in a well-hedged paddock with probably high shelter on the weather boundary. The distance between rows and plants will vary with the quality of the land and the variety being planted, but for gooseberries and currants it should not be less than 5 ft. For black currants and raspberries it is generally advisable to plant the rows 6 ft. apart and 3 ft. between plants, the raspberries being planted in groups of three canes. A very good alternative method of planting raspberries is to set the canes singly 1 ft. apart in the row.

In the warmer localities most of the following fruits may be grown on suitable land: The Cape gooseberry (*Physalis peruviana*) is a herbaceous plant cut down by frost in winter, but shooting again from the crown in spring. Good forward plants set out 3 ft. apart and 6 ft. between rows, in a light, rich, warm soil, during the early part of November, should crop well during the autumn for two or three seasons. The tree-tomato (*Cyphomandra betacea*) is enjoying an increasing popularity. This half-woody plant with large soft leaves grows here usually to a height of about 6 ft. It should be planted about 3 ft. apart in a fertile soil with ample shelter. The crop ripens in winter when not many kinds of fruit are available. The guava and also the feijoa are fruiting-shrubs from the warmer parts of South America. Planted as informal hedges in the less exposed positions they should crop satisfactorily if the soil is good and care has been taken in the choice of varieties. Seedling plants may be bought cheaply, but they are rarely so good as selected varieties grown from cuttings, &c.

The Chinese gooseberry (*Actinidia chinensis*), the passion-vine (*Passiflora edulis*), the loganberry, and the grape-vine are all vines requiring support—it usually takes the form of a post and wire fence about 4 ft. to 5 ft. high, but a wall with strained wires at intervals or a pergola is very suitable for the purpose in the home garden. As the Actinidia is commonly diœcious, that is, it has staminate and pistillate flowers on different plants, both kinds must be planted to produce fruit. In a rich, moist soil the fruit is produced fairly abundantly, and ripens in winter.

Fruiting-trees of moderate to fair height and suited to a mild climate are the loquat (*Eriobotrya japonica*), the avocado (*Persea gratissima*), the olive, the fig, and the pomegranate. The first three are evergreens and the remainder deciduous, but they are alike in requiring a light, deep soil. A number of unsatisfactory trees of the kinds above mentioned are growing in many parts of the country. In a few instances it may be that the soil or climate is unsuitable, but, generally, it is due to the fact that the trees are seedlings and comparatively worthless under any conditions, or the variety is not suited to the locality. Planting as a rule should not be done unless the variety has proved itself suitable to the locality or one very similar. The avocado is indigenous to Mexico and Central and South America, but is now distributed in most tropical and subtropical countries. Those varieties likely to do best here are those derived from varieties growing in Mexico, where, growing for centuries at an altitude of from 6,000 ft. to 7,000 ft., they easily withstand fairly sharp winter frosts. The introduction of some of the trees mentioned has not been carried sufficiently far to warrant commercial planting at present, but selected varieties are certainly worth a place in the home garden, as their beauty and utility are considerable.

The Tomato Crop under Glass.

For this crop the seed is sown during the month of May or early June. In the light of past experience the chief precautions are to see that sound seed of a suitable variety and good strain is used, and the seed-boxes when sown are kept at a temperature of about 60° F. More than 5° F. above or below that temperature is decidedly detrimental. This means considerable supervision, which must be provided, or, debilitated by unsuitable conditions, the plants will fall an easy prey to pests and diseases of which there are usually far too many ready for such an opportunity. After watering the seed in, covering with glass and shading with paper, more water will not be required probably until the seedlings are pricked off. In any case water should be used sparingly and should always be tepid. In this way the plants are grown steadily and have a sturdiness that is the very best preventive for disease.

Where the glasshouse and soil in which the crop is to be grown have been thoroughly cleansed, as described in the January number, the green crop that may be sown should be trenched in as soon as it comes into flower, which is the indication that the growth is completed. Only rarely does one find that in doing this the soil from below has been placed on top. This should be avoided, as the result is likely to be disastrous. Where a green crop is not available, and the land requires the addition of humus, well-fermented stable or farm manure should be spread and dug in after trenching. These operations should be done without delay and not left until one is nearly ready to plant.

Vegetable Crops.

Plantations of such perennial crops as asparagus, rhubarb, and sea-kale should now be cleaned up and given a dressing of fermented farm manure where humus is lacking. Where new plantings are to be made a light, rich, moist soil is most suitable It should now be double-ploughed or trenched, and a generous application of manure turned in deeply in readiness for planting later.

During the month of May it is found profitable in many districts to sow peas of an early variety and also broad beans. In frost-free localities early potatoes are also sown ; as these are for early digging they may be sown rather closely with advantage

Stored produce will require close attention for another month, especially as regards ventilation.

The Homestead Garden.

The time is now arriving when plans for the planting-season may be put into operation. By trenching round a tree or shrub and undermining it until it is free, then rocking it carefully while refilling the hole, a large plant with roots practically entire may be brought to the surface, laid on its side, and rolled on to a sledge for removal. By keeping the roots covered with wet sacks until it is safely replanted, the operation can be carried out successfully with comparatively few losses. In this way a few readjustments in the planting-arrangement may often be done now with great advantage. After resetting the plant it is well to reduce the top considerably so that transpiration may be adjusted to the capacity of the diminished root, and to see that the plant does not suffer from want of water. Unsuitable trees too large for removal should be chopped out altogether.

It is advisable to take delivery of new plants from the nursery as soon as they are available. Where the planting-arrangement has been fully planned and the ground prepared the plants may be set out at once if the ground is friable and free from any stickiness. Trim away neatly any broken or straggling roots, and plant firmly to the same depth as previously. Shorten the tops moderately to reduce wind resistance ; carefully considered pruning treatment can be given later. Conifers and a few kinds of evergreens are exceptions to this pruning rule.

When planting has to be deferred the plants should be carefully unpacked, checked over, and heeled in. This is done by opening a trench in friable soil, standing the trees closely in the trench, and filling in the fine soil amongst them in order to cover the roots well. Exposure of the roots should be avoided as much as possible, and roots should not be allowed to become dry.

New lawns should be trimmed as soon as the grass is long enough for cutting. It is advisable to use a mower that is in good order and set to cut high—generally as high as possible. The lawn should be cut when the grass is dry and afterwards rolled with a light roller. Those who are not so forward with the work should continue the preparation, and if it is completed too late for autumn sowing it may be done in spring-time.

—W. C. Hyde, Horticulturist, Wellington.

WEATHER RECORDS: MARCH, 1934.

Dominion Meteorological Office.

Notes for March.

In much the greater part of the North Island March was very dry. In the South Island conditions were more varied, and a most important feature was the breaking of the drought in Nelson and Marlborough by the heavy rains of the 27th. Temperatures were considerably below normal, but this was not altogether an unfavourable circumstance, since in combination with a general absence of strong winds it tended to mitigate the effects of the lack of rainfall, especially in the middle of the month.

Rainfall.—The only considerable area of the North Island which had more than the average rainfall included most of western Wellington south of Wanganui and extended to the northern Wairarapa. Over the rest of the Island the totals averaged only about half the normal, and the central and north-eastern districts recorded a particularly dry month. In the South Island an area in North Canterbury and south Marlborough had double the usual fall for March. Westport also had a heavy fall. Elsewhere conditions varied considerably, but excesses were rather less numerous than deficits.

Temperatures.—The month was a distinctly cold one. At most places the mean temperature was between 1 degree and 2 degrees below normal. A few frosts were recorded.

Sunshine.—In eastern districts of the South Island from Canterbury southwards cloudy and humid conditions prevailed, and sunshine was much below normal. Elsewhere totals were generally either equal to or better than average.

Pressure Systems.—A marked characteristic of the general situation was the disturbed conditions which prevailed in the tropics. Damage was done by cyclones in Australia on both the north-west and the Queensland coasts, while several less violent storms occurred in the area to the east of Australia. Associated with these conditions were a number of intense and widespreading anticyclones which occurred in New Zealand latitudes. In several the pressure at the centre exceeded 30·5 in., and the mean pressure for the month was considerably above normal.

On the 1st a shallow cyclone was located west of the Auckland Peninsula. This crossed the Peninsula during the night and was followed closely by a depression which had a cyclonic centre in its southern portion where it passed over Otago. Almost general rains resulted, with thunderstorms in places.

A westerly depression passing quickly between the 5th and the 7th was responsible for some very stormy weather. Thunderstorms were widespread on the night of the 7th, and in Canterbury there were some severe hailstorms. Snow fell on the ranges, the falls on Mount Egmont and at the National Park being unusually heavy.

Another rapidly moving westerly depression was responsible for some heavy rains in western districts of the South Island on the 12th.

The most important storm was cyclonic in form and moved slowly through Cook Strait between the 26th and 28th. General rains were recorded with many heavy falls, especially in the central portions of the Dominion. Falls of between 1 in. and 2 in. were recorded in the areas of Nelson and Marlborough, where drought had previously prevailed. Particularly heavy falls occurred in parts of North Canterbury and the Kaikoura districts, where rivers and creeks were in high flood. This rain and that of the 2nd were the only general rains.

RAINFALLS FOR MARCH, 1934, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average March Rainfall.	Total for Year to Date.	Average for Year to Date.
			North Island.			
	Inches.		Inches.	Inches.	Inches.	Inches.
Kaitaia	1·94	7	1·70	3·10	7·47	10·54
Russell	3·46	7	2·80	3·28	8·59	9·52
Whangarei	2·94	11	1·96	4·45	9·77	12·25
Auckland	1·67	9	0·84	3·02	11·41	8·86
Hamilton	1·36	7	0·60	3·76	7·43	10·24
Rotorua	0·84	9	0·48	3·49	11·24	11·44
Kawhia	2·34	7	0·96	4·21	12·19	9·83
New Plymouth ..	2·42	10	0·90	3·72	10·36	11·70
Riversdale, Inglewood ..	5·80	11	1·72	7·04	13·82	20·58
Whangamomona ..	..	..	..	4·98	..	14·45
Hawera	2·43	8	0·90	3·01	9·80	8·92
Tairua	2·85	5	1·98	5·21	10·43	13·55
Tauranga	1·51	11	0·62	3·98	11·96	11·57
Maraehako Station, Opotiki	1·20	10	0·56	3·96	9·37	11·69
Gisborne	0·60	11	0·14	4·42	7·77	10·60
Taupo	0·89	6	0·46	3·14	11·29	9·25
Napier	0·96	8	0·32	3·13	10·86	8·84
Hastings	1·09	7	0·36	2·76	8·94	6·94
Whakarara Station ..	1·20	10	0·36	..	16·31	..
Taihape	1·46	8	0·61	2·61	9·06	8·00
Masterton	..	..	..	2·81	..	8·14
Patea	2·44	9	0·72	3·35	11·19	9·34
Wanganui	2·22	7	0·66	2·47	11·68	7·72
Foxton	3·43	6	1·88	1·98	8·36	6·19
Wellington	2·44	12	1·30	3·11	7·98	8·59
			South Island.			
Westport	14·10	15	3·32	7·50	25·45	21·05
Greymouth	..	..	..	8·80	..	24·18
Hokitika	6·16	13	1·30	9·64	17·96	26·90
Ross	8·30	14	1·33	10·73	25·18	32·03
Arthur's Pass ..	11·38	10	2·90	13·19	29·07	37·21
Okuru, South Westland	..	..	..	14·15	..	36·40
Collingwood	5·53	11	3·25	5·81	11·94	17·68
Nelson	3·15	8	1·52	2·91	6·26	8·35
Spring Creek, Blenheim	1·73	5	1·22	1·98	3·47	6·38
Hanmer Springs ..	7·16	10	3·86	3·20	18·87	10·30
Highfield, Waiau ..	6·10	6	4·12	2·84	12·97	8·42
Gore Bay	..	..	..	2·13	..	7·39
Christchurch	1·78	10	0·44	1·98	6·75	5·90
Timaru	2·15	11	0·68	2·20	10·79	6·31
Lambrook Station, Fairlie	2·21	9	0·59	2·34	9·07	6·58
Benmore Station, Clearburn	2·34	10	0·63	2·41	6·02	6·80
Oamaru	1·29	13	0·58	1·78	7·17	5·61
Queenstown	3·37	12	0·98	2·61	6·51	7·47
Clyde	1·75	9	0·53	1·49	5·61	4·40
Dunedin	2·50	18	0·56	2·94	10·32	9·10
Wendon	3·51	13	0·70	2·74	7·96	8·20
Gore	..	..	..	3·25	..	8·98
Invercargill	4·57	20	0·94	3·87	10·36	11·00
Puysegur Point ..	7·90	23	2·07	7·97	16·86	21·33
Half-moon Bay ..	3·55	19	0·53	5·37	10·53	14·27

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

RUPTURE IN PIGS.

F. L. S., Studholme Junction :—

I have a litter of pigs three weeks old, of which two of the male pigs appear to be ruptured. Can I castrate in usual manner or will bowel of pig come out ? I would appreciate any information you can give me regarding this matter. If incurable, could I keep them until big enough to kill for own use—say, 40 lb. weight ? May this trouble be the fault of a parent, as in this case I suspect the boar ?

The Live-stock Division :—

The castration of a ruptured animal by the usual method is generally followed by a prolapse of the bowel and cannot be recommended. A special operation known as the " covered " operation should be performed if castration is decided upon. There is no reason why you should not keep the pigs for your own use, but it is advisable to fatten them as quickly as you possibly can, thus avoiding a possibility of what is known as " boar taint." Congenital predisposition is generally considered to be the cause of rupture in young pigs.

FEEDING BARLEY TO POULTRY.

G. H. M., Seddon :—

In regard to the Wallaceville barley-feeding trial for experimental purposes, would you be good enough to inform me what variety of barley was used, and if hulled or not ? Can you say if barley-meal could be used with advantage in a ration for laying-ducks, and, if so, what should be the composition of such a ration ?

The Live-stock Division :—

Whole (not hulled) barley of a the chevalier variety was used. In the feeding trials the barley-fed birds were fed the following wet mash ration : Barley-meal, 32 lb. ; pollard, 14 lb. ; bran, 18 lb. ; meat-meal, 7 lb. (approximately 10 per cent.). If barley-meal 2 parts and bran 1 part were used to form a mash for feeding to ducks it probably would be advisable to increase the amount of meat content from 10 per cent. to say 12 per cent., according to the production of the birds, and also to see that ample green feed was supplied. The question of whether barley-meal could be fed to advantage instead of the ordinary ration of pollard and bran depends on the prices of barley-meal and pollard.

APHIS ON CABBAGE FAMILY.

R. H. S., Lumsden :—

In my vegetable garden, the cabbage family, notably Brussels sprouts, are troubled with an insect which gathers in colonies on the leaves—a small roundish and soft blue-green blight which makes the leaves curl. Can this be controlled in some economical way ?

The Horticulture Division :—

From the description given there is little doubt they are colonies of aphides which infest the cabbage-plants. Where only a few plants are concerned spraying with a strong soap solution weekly is a good method of keeping young plants free from this pest. Large crops may be treated by placing a pinch of tobacco powder in the heart of the plant or dusting plants with tobacco powder, as may be necessary. If the treatment is commenced early it will prevent the establishment of the colonies.